

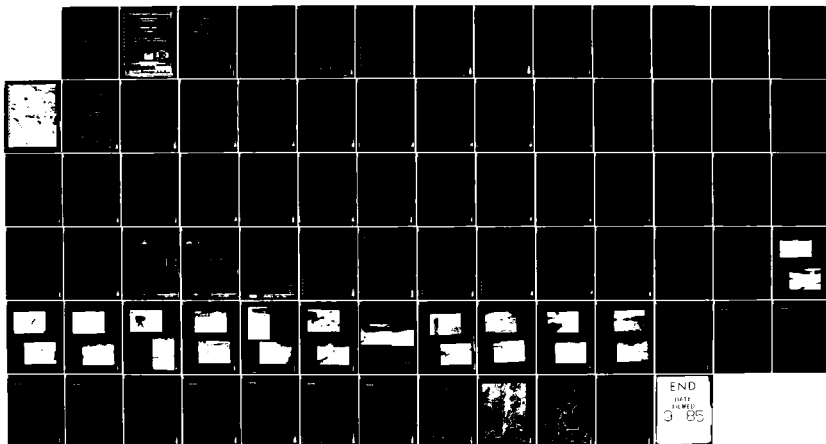
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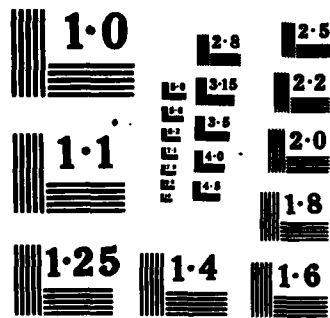
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
DUFRESNE DAM (VT 0014...101 CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV JAN 79

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ENGINE INSPECTION REPORT
NATIONAL ORAL INSPECTION PROGRAM

DTC

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Upper Hudson River Basin Manchester, VT. Batten Kill River		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The dam is a 262 ft. long, 12 ft. high earth embankment dam. The dam is generally in good condition. The inspection revealed no immediate safety problems. It is small in size with a significant hazard potential. The test flood is $\frac{1}{2}$ the FIV. It is recommended that the owner engage a qualified engineer to further evaluate the potential for overtopping and the inadequacy of the spillway.		

DUFRESNE POND DAM

VT 00144

UPPER HUDSON RIVER BASIN
MANCHESTER, VERMONT

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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LETTER OF TRANSMITTAL
FROM THE CORPS OF ENGINEERS TO THE STATE
TO BE SUPPLIED BY THE CORPS OF ENGINEERS

NATIONAL DAM INSPECTION PROGRAM
PHASE I - INSPECTION REPORT
BRIEF ASSESSMENT

Identification No.: 00144
Name of Dam: Dufresne Pond
Town: Manchester
County and State: Bennington, Vermont
Stream: Batten Kill River
Date of Inspection: November 9, 1978

Dufresne Pond Dam is a 262 foot long, 12 foot high earth embankment dam. This dam was originally constructed in 1908, with portions being reconstructed in 1957 and 1962. A concrete core wall, ranging from 1.0 to 1.5 feet in width, extends through the embankment, presumably for its entire length. The appurtenant works consist of a 40 foot concrete spillway, outlet works consisting of two 4.5 foot wide sluiceway sections, service bridge and discharge channel. Engineering data available consisted of a plan dated 1962 showing plan, elevation and details of additions and improvements to the outlet works structure. No construction specifications or design calculations were available.

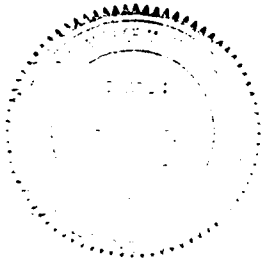
The visual inspection of Dufresne Pond Dam revealed no immediate safety problems. The general condition of the dam is good. The inspection revealed seepage at the abandoned outlet drain pipe, a cracked left training wall of the spillway section and displacement of the marble riprap along the discharge channel floor at the spillway section.

Based on the dam's small size and significant hazard classification in accordance with the Corps guidelines, the test flood is one-half the PMF. The spillway will pass only about 7 percent of the test flood and is considered inadequate. Under test flood conditions, the dam would be overtopped by approximately 5.0 feet. The railroad embankment through the reservoir may change the effect of surcharge storage and divert flow.

It is recommended that the owner engage a qualified engineer to further evaluate the potential for overtopping

and the inadequacy of the spillway. Provisions should be made by the owner to continue observation of seepage at the abandoned outlet drain pipe, to continue observation of the spillway channel floor for possible erosion beneath the paving, and to repair the left training wall of the spillway section.

The recommendations and remedial measures are described in Section 7 and should be addressed within two years after receipt of this Phase I - Inspection Report by the owner.



Gordon H. Slaney, Jr.

Gordon H. Slaney, Jr.
Project Engineer

Howard, Needles, Tammen & Bergendoff
Boston, Massachusetts

This Phase I Inspection Report on _____ Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

THIS SHEET TO BE FURNISHED BY THE CORPS OF ENGINEERS

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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SECTION 5
HYDROLOGY AND HYDRAULIC ANALYSIS

5.1 Evaluation of Features

a. General. Dufresne Pond Dam is an earthfill structure with a total length of approximately 263 feet and a maximum structural height of 12 feet. The appurtenant works consist of a 40 foot spillway and an outlet works structure. The outlet works structure consists of two stoplog sluiceway sections, each having an opening 4.5 feet wide by 12.0 feet in height.

The dam creates an impoundment of water primarily used for recreational purposes. Dufresne Pond Dam is classified as being small in size having a maximum storage of 100 acre-feet.

b. Design Data. No hydrologic or hydraulic design data were disclosed for Dufresne Pond.

c. Experience Data. No maximum flows have been recorded at this site. However, in June 1973, the dam was overtopped and sandbags were placed on the dam crest. It was reported that the storm was of a 25 year return frequency in that area.

d. Visual Observations. No evidence of damage to any portion of the project from overtopping was visible at the time of the inspection.

e. Overtopping Potential. As no detailed design and operational information are available, hydrologic evaluation was performed using dam information gathered by field inspection, watershed size and an estimated test flood equal to 1/2 the Probable Maximum Flood (PMF) as determined by guide curves issued by the Corps of Engineers. Based on a drainage area of 18.4 square miles, it was estimated that the test flood inflow at Dufresne Pond Dam would be 13,500 cfs. Following the guidance for Estimating Effect of Surcharge Storage on Maximum Probable Discharge results in a test flood discharge of 13,315 cfs. As the maximum spillway capacity at the top of the dam is only 920 cfs (approximately 7 percent of the test flood discharge flow), the test flood will result in the dam being overtopped by approximately 5.0 feet. The railroad embankment through the reservoir may change the effect of the surcharge storage and divert flow. Diverted flow would run along the railroad embankment, by-pass the dam and return to the river below the dam. A more detailed

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedure

The Dufresne Pond Dam creates an impoundment of water which is primarily used for recreational purposes. Discussions with the owner revealed that normal operation has the stoplogs installed in the sluiceway to or just below the spillway elevation. Thus the stoplogs and/or spillway control the pond's water level on a year-round basis.

4.2 Maintenance of Dam

Grounds work, painting and debris removal work are all performed on an as needed basis.

During 1957 and 1962, repairs were made to the dam which included the reconstruction of the outlet works structure. Presently, this dam is inspected bi-annually by the State's dam safety engineer.

4.3 Maintenance of Operating Facilities

Maintenance on the outlet works facilities is done on an as needed basis.

4.4 Description of Warning Systems

There are no warning systems in effect at this facility.

4.5 Evaluation

The current operation and maintenance procedures for Dufresne Pond Dam are inadequate to insure that all problems encountered can be remedied within a reasonable period of time. The owner should establish a written operation and maintenance procedure as well as establishing a warning system to follow in event of flood flow conditions or imminent dam failure.

is exposed in the spillway channel and can be seen in the foreground of Photo 13. The juxtaposition of the paving blocks pose no immediate threat to the safety of the dam. The right training wall of the discharge channel is in good condition. Details of this wall are shown on Figure 1 in Appendix B and Photos 14 and 22.

d. Reservoir Area. The reservoir slopes are generally covered with trees and brush on the left banks and farm pastureland on the right banks. A more detailed description of the drainage area is included in Section 1.3 of this report. The amount of siltation within the reservoir is not known.

e. Downstream Channel. The downstream channel, beyond the marble lined discharge channel, has a gravel and rock bottom and appears clean. Approximately 150 feet downstream of the dam is a wooden bridge with a wood log center pier. This bridge provides access to the house located to the right of the downstream channel, immediately downstream of the dam. Beyond the bridge, several houses line the left bank, several feet above the channel elevation. The right bank is lined with trees. Three thousand feet downstream, the channel passes under Route 30 and a railroad bridge. In Manchester Depot, the channel passes several dwellings and business establishments which are only 4 or 5 feet above the channel elevation.

3.2 Evaluation

Visual examination did not disclose any findings that indicate an immediate unsafe condition. The condition of the dam is generally good. The inspection revealed the following:

- (a) Seepage at the abandoned outlet drain pipe.
- (b) Cracked left training wall of the spillway section.
- (c) Displacement of marble block riprap along the discharge channel floor at the spillway section.

channel leading from the outlet to the river. The drainage channel is shown in Photo 11.

c. Appurtenant Structure. Visual inspection of the concrete spillway, outlet works structure, discharge channel and service bridge structure did not reveal any evidence of stability problems. The concrete surface generally appeared to be in good condition except for one vertical and two long horizontal cracks in the left training wall separating the dam's embankment from the spillway structure. (Photos 18 and 19).

The spillway section consists of a concrete gravity wall, shaped as shown on Section B-B, Figure 1 (located in Appendix B) and two training walls. The right training wall and the concrete spillway surface are in good condition with no visible cracks or other concrete deterioration being observed. The left training wall is badly cracked above the spillway crest level. The extent of the cracking can be seen in Photos 18 and 19. The deteriorated concrete observed during this inspection could, if not repaired, be exposed to further deterioration and could eventually lead to a partial collapse of the left training wall. The integrity of this wall is important to both the embankment and the service bridge structure.

The outlet works structure, shown in Photos 16 and 17, is formed by two concrete walls with one pier in the middle. The outlet works contains two sections with stoplogs, each with an effective opening of 4.5 feet wide by 12.0 feet high. The outlet works structure is located just above the river bed elevation between the spillway structure and right abutment. The concrete surface of this structure appears to be in good condition.

The service bridge over the spillway and outlet works is a simple span truss-type structure. The plank floor is connected to the bottom cord of the truss and the top cord is used as a railing. All structural and bracing members of the bridge are structural steel standard shapes. The service bridge appears to be in sound condition. No misalignment of the bridge or supporting structures that could be related to embankment movements was observed.

The floor of the discharge channel immediately below the spillway has been paved with cut marble blocks. Some of these blocks have been displaced presumably due to water flowing over the spillway. This paved area in the spillway channel is shown in Photo 13. The marble blocks are underlain by large boulders and in some areas bedrock. Bedrock

SECTION 3 VISUAL INSPECTION

3.1 Findings

a. General. The field inspection of Dufresne Pond Dam was made on November 9, 1978. The inspection team consisted of personnel from Howard, Needles, Tammen & Bergendoff and Geotechnical Engineers, Inc. A representative of the State of Vermont Water Resources Board was also present during the inspection. Inspection checklists, completed during the visual inspection are included in Appendix A. At the time of the inspection, the water level was approximately 2 feet below the permanent spillway elevation. No water was passing over the spillway. The upstream face of the dam could only be inspected above this water level.

b. Dam. Visual inspection of the embankment showed no signs of distress.

Upstream Slope

The upstream slope of dam does not have riprap slope protection. A dense grass and turf cover is visible above the waterline. There are no signs of slumping or erosion on the upstream slope above the waterline.

Crest

The crest of the dam is about 19 feet wide including a section which is paved with cut marble slabs. This paved section is about 8 feet 6 inches wide extending downstream of a concrete core wall, as shown in Photo 4. Upstream of the core wall the crest is well turfed.

Downstream

The downstream slope of the dam is about 3 horizontal to 1 verticle and is faced with cut marble blocks that are between 6 and 9 inches thick. The downstream paved slope is shown in Photo 10.

At the toe of the downstream slope at a point about 60 feet from the left training wall of the spillway is an abandoned outlet structure shown in Photos 8 and 9. Water is flowing from the outlet at a nearly undiscernible rate. The water flowing from the pipe is clear, and there are no silt deposits at the end of the outlet or along the drainage

SECTION 2 ENGINEERING DATA

2.1 Design

No original design data were disclosed for Dufresne Pond Dam. A drawing (1 sheet) dated 1962 showing addition of the right training wall was the only design information found.

2.2 Construction

No construction records were available for use in evaluating the dam.

2.3 Operation

No engineering operational data were disclosed.

2.4 Evaluation

a. Availability. Engineering data available for Dufresne Pond Dam is limited to the plan mentioned above. This plan is on file at the State of Vermont, Agency of Environmental Conservation, Department of Water Resources, Water Quality Division.

b. Adequacy. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance and sound engineering judgment.

c. Validity. The field investigation indicated that the external features of Dufresne Pond Dam were somewhat different than those shown on the available plans, and therefore field measurements were made to update plan information.

deck bridge 150 feet downstream with a 40 foot wide opening in two spans with a six foot rise. Below the bridge the channel is lined with trees.

j. Regulating Outlets. Reservoir level can be controlled with the two 4.5 foot openings, with inverts at 710.0, by stop-logs. The maximum discharge capacity of the two 4.5 foot wide sluiceways, with the water surface at the top of dam, is approximately 1080 cfs. In addition, there is a 24 inch diameter drain pipe to the left of the spillway training wall. The drain is reported to be plugged and apparently abandoned.

(2) Flood Control Pool - N/A.

(3) Spillway Crest - 12.8.

(4) Test Flood Pool - 16.

(5) Top Dam - 16.

g. Dam

(1) Type - earth embankment.

(2) Length - 262.8 feet, overall.

(3) Height - 12 feet (maximum).

(4) Top Width - 19 feet.

(5) Side Slopes - US = 3:1; DS = 3½:1.

(6) Zoning - unknown.

(7) Impervious core - concrete wall.

(8) Cutoff - unknown.

(9) Grout Curtain - unknown.

(10) Other - none.

h. Diversion and Regulating Tunnel

None.

i. Spillway

(1) Type - concrete ogee.

(2) Length of Weir - 40 feet.

(3) Crest Elevation - 719.0.

(4) Gates - none.

(5) U/S Channel - none.

(6) Downstream Channel. Immediately downstream of the dam the channel bottom is lined with cut marble blocks, beyond which is a gravel and rock invert. There is a wood

(3) The spillway capacity with the water surface at the top of dam is approximately 920 cfs at elevation 722.0 feet.

(4) The spillway capacity with the water surface at the test flood elevation is approximately 3,860 cfs at elevation 727.0.

(5) The total project discharge at the test flood elevation of 727.0 is approximately 13,315 cfs.

c. Elevation (feet above MSL)

- (1) Streambed at centerline of dam - 710.0.
- (2) Maximum tailwater - unknown.
- (3) Upstream portal invert diversion tunnel - none.
- (4) Recreation pool - 719.0 varies.
- (5) Full flood control pool - N/A.
- (6) Spillway crest (permanent spillway) - 719.0.
- (7) Design surcharge - unknown.
- (8) Top Dam - 722.0.
- (9) Test Flood Surcharge - 727.0.

d. Reservoir (miles)

- (1) Length of Maximum Pool - 0.4.
- (2) Length of Recreational Pool - 0.38.
- (3) Length of Flood Control Pool - 0.4.

e. Storage (Gross Acre-Feet)

- (1) Recreation Pool - 52.
- (2) Flood Control Pool - N/A.
- (3) Spillway Crest Pool - 52.
- (4) Top of Dam - 100.

f. Reservoir Surface (Acres)

- (1) Recreation Pool - 12.8.

h. Design and Construction History. This dam was originally constructed in 1908 to supply process water for a mill. Reconstruction of the dam in about 1957 eliminated the process water intake and included repairs to the dam and spillway. In 1962 a major landslide occurred in the right abutment hillside immediately downstream of the outlet works. At about this time, the landslide area was regraded and seeded and a concrete retaining wall was built at the toe of the slope forming a training wall downstream of the outlet works. A plan of this wall construction, prepared by Haley and Ward engineers, is on file with the State of Vermont Agency of Environmental Conservation.

i. Normal Operating Procedure. There are no written operational procedures for this dam. The dam is normally left to operate year round at the spillway crest elevation or with one or two stoplogs removed.

1.3 Pertinent Data

a. Drainage Area. The drainage area tributary to Dufresne Pond Dam consists of 18.4 square miles of rolling terrain. The upper reach of the basin is steep, heavily wooded land, and the lower basin is flat to rolling (channel slope 22 feet/mile) with woods and open land. The periphery of Dufresne Pond is comprised of wooded and farmland areas with one residence and an abandoned mill building located near the reservoir.

The maximum reservoir area of 16.0 acres is very small in comparison to the total watershed. The reservoir is divided by railroad tracks and embankment. The size of the waterway opening through the embankment is approximately 58 feet wide by 9 feet high. All areas in the basin are well vegetated with manmade imperviousness being limited to a few paved roads and housing. Topographic elevation in the watershed ranges from about 3,300 to 710 feet MSL.

b. Discharge at Dam Site.

(1) The outlet works for Dufresne Pond Dam consist of two 4.5 foot openings set on a concrete platform at the approximate stream invert elevation of 710 MSL. The pond behind the dam can be lowered about 12 feet below the dam crest elevation of 722.0 by removing all stoplogs from the sluiceway section. This drawdown would lower the reservoir area to the original river bed elevation of approximately 710.

(2) The actual maximum discharge at the dam is unknown, but in June of 1973, the dam was overtopped and sandbags were required.

b. Description of Dam and Appurtenances. Dufresne Dam is an earthfill structure approximately 12 feet high and 262 feet long. A concrete core wall, ranging from 1.0 to 1.5 feet in width, extends through the embankment, presumably for its entire length. The height of the core wall is not known but it is assumed to be equal to the height of the dam. The fill material upstream of the core wall consists of dumped gravel having a side slope of about 3 feet horizontal to 1 foot vertical (3:1). The fill material downstream of the core wall is assumed to be gravel. The slope of the downstream face is about 3½:1. The upper half of the downstream face is covered with marble blocks.

The appurtenant works consist of a concrete spillway, outlet works consisting of sluiceway with stoplogs, service bridge (simple span, steel truss type structure) and discharge channel. The sluiceway and spillway are located at the right abutment of the dam.

Figure 1, located in Appendix B, shows the plan of the dam and its appurtenant structures. Photographs of each structure are shown on Appendix C.

c. Size Classification. Small (hydraulic height - 12 feet high, storage - 100 acre-feet) based on storage (≥ 50 to 1,000 acre-feet) as given in Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. The dam's potential for damage rates it as a significant hazard classification. The breach of dam discharge represents a rise in stage of about 4 feet for a total 8 foot stage in Manchester Depot 1 mile downstream of the dam. Six to ten dwellings and several commercial establishments would be effected with the potential for the loss of a few lives.

e. Ownership. This dam is owned by the State of Vermont Fish and Game Department, Montpelier, Vermont 05602. The dam was formerly owned by Cham Dufresne.

f. Operator. This dam is maintained and operated by the State of Vermont Fish and Game Department. The State's Dam Safety Engineer is Mr. A. Peter Barranco, Jr., P.E. Mr. Barranco is located at the Agency of Environmental Conservation, Department of Water Resources, Water Quality Division, Montpelier, Vermont 05602. Telephone No. (802)828-2761.

g. Purpose of Dam. The purpose of this dam is primarily to create an impoundment of water for recreational use.

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
DUFRESNE POND DAM

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Howard, Needles, Tammen & Bergendoff has been retained by the New England Division to inspect and report on selected dams in the State of Vermont. Authorization and notice to proceed were issued to Howard, Needles, Tammen & Bergendoff under a letter of October 23, 1978 from John P. Chandler, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0356 has been assigned by the Corps of Engineers for this work.

b. Purpose

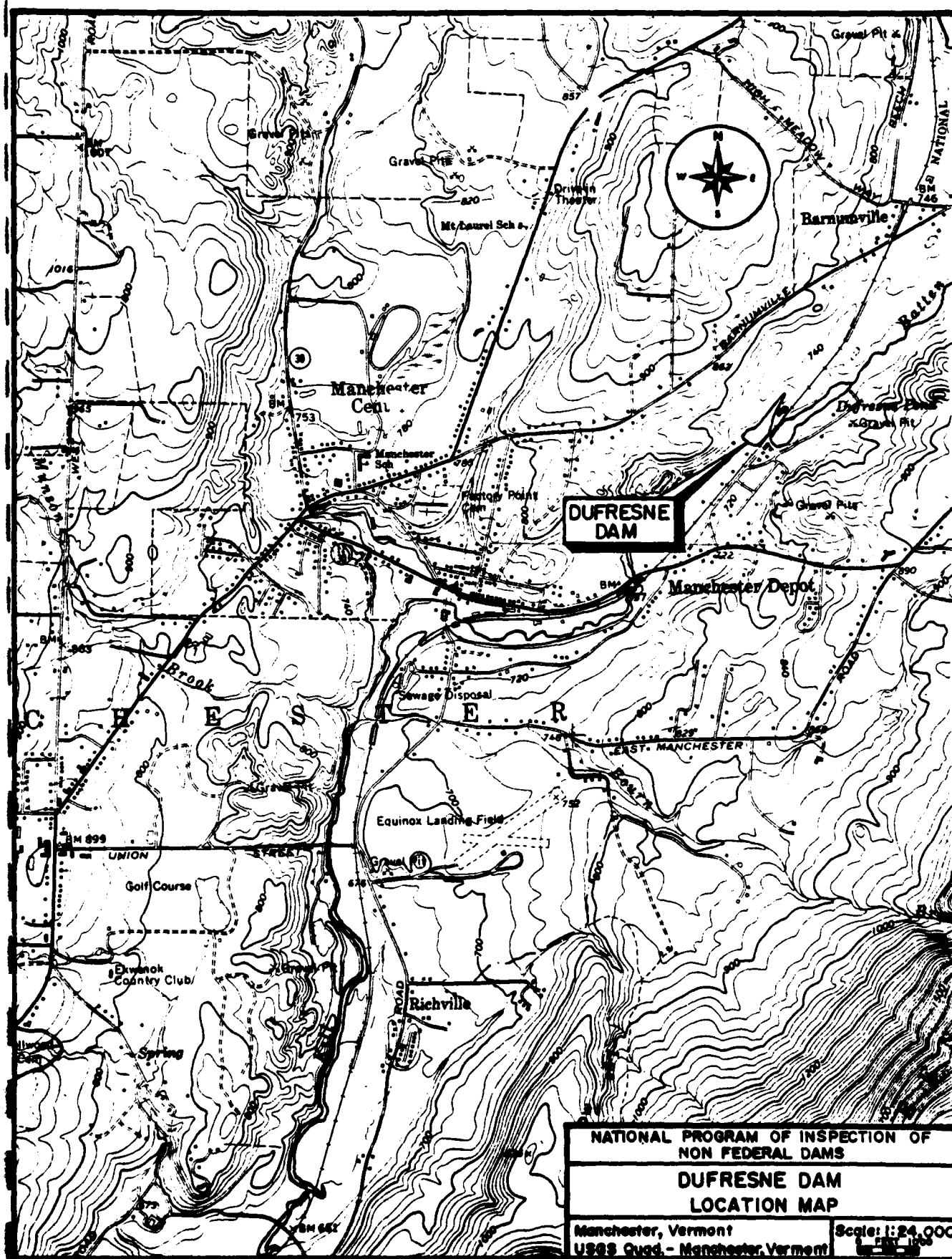
(1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

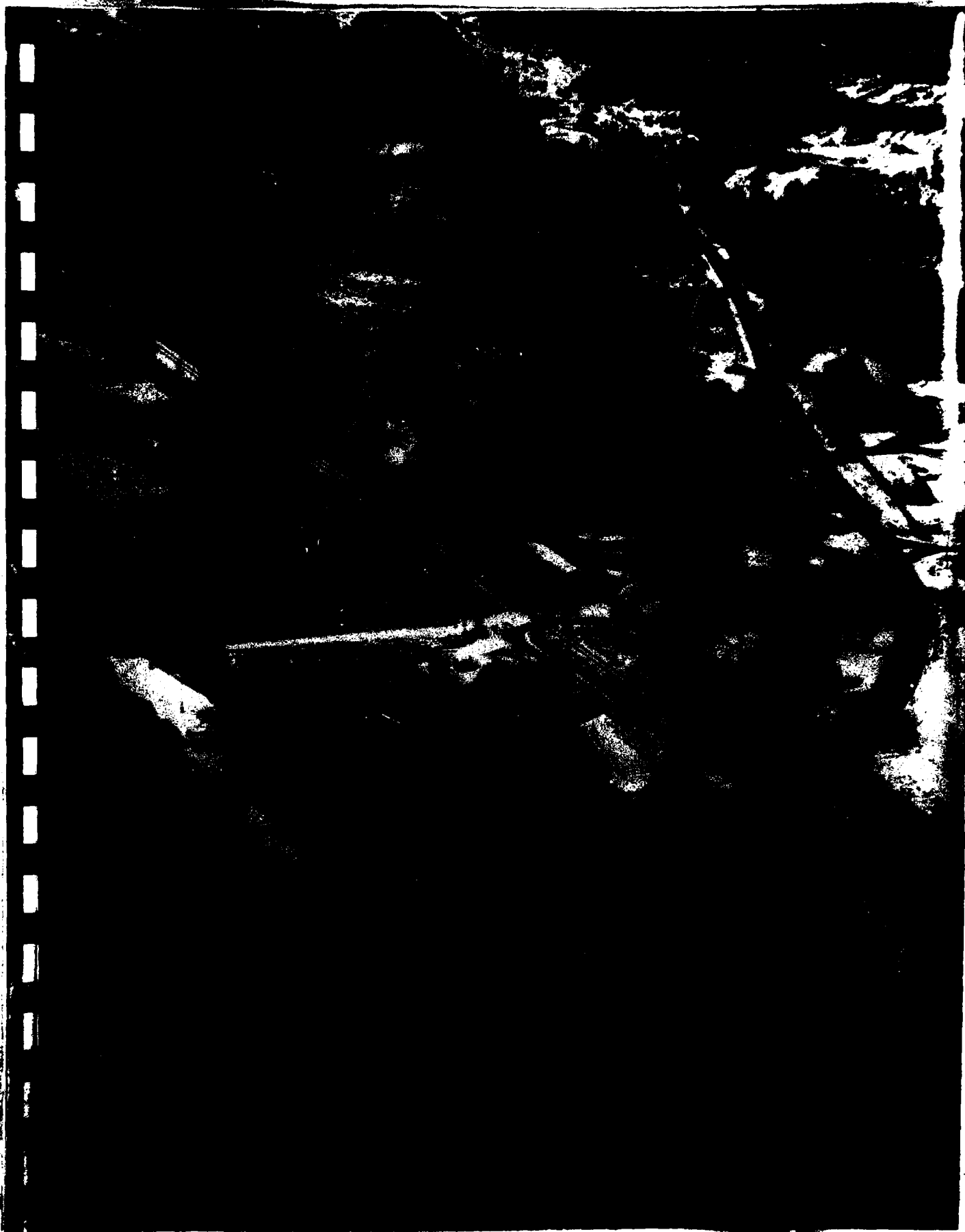
(2) To encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Dufresne Dam is located on the Batten Kill River, 7,500 feet upstream from its confluence with the West Branch in the Town of Manchester, Vermont. The dam is shown on U.S.G.S. Quadrangle, Manchester, Vermont, with coordinates approximately N43°10'43"W73°01'48", Bennington County, Vermont. Dufresne Pond Dam's location is shown on the Location Map immediately preceding this page.





DUFRESNE DAM - Overview looking upstream

hydrologic/hydraulic analyses along with topographical data will be required to assess the total impact of the railroad embankment.

f. Dam Failure Analysis. The impact of failure of the dam at maximum pool (top of dam) was assessed using the "Rule of Thumb" Guidance for Estimating Downstream Dam Failure Hydrographs issued by the Corps of Engineers. The analysis covered the reach extending from the dam to Manchester Center. Failure of the dam would probably result in a flood wave stage of 9.5 feet (including spillway discharge) at the Route 30 bridge 3,000 feet downstream. Flood stage in Manchester Center would be about 8.2 feet. In the reach from the dam to Manchester Center, about 10 dwellings and several commercial establishments would be effected. The large difference in the spillway discharge outflow of 920 cfs and the peak breach outflow 7,340 cfs would threaten life in only a narrow area adjacent to the stream channel to result in a significant hazard classification. It should be noted that due to the relatively small volume of impounded water behind Dufresne Pond Dam that the actual test flood flows passing the dam, assuming the dam did not fail, would have the potential of creating the same, if not greater, damaging effects on the downstream channel area than would occur under breach failure analysis.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The visual inspection did not disclose any immediate stability problems.

b. Design and Construction Data. Various inspection reports, correspondence and drawings made available for this inspection indicate that a dam about 250 feet long and 12 feet high was built at the site in about 1908. This original dam consisted of a masonry spillway section with embankments leading from the spillway to each abutment. The embankment was described as gravel and stone fill retained by dry masonry walls. A document dated November 8, 1948 indicates there was a concrete core wall extending through the embankment. A portion of this core wall can presently be seen on the crest and is shown in Photo 4 separating the grass covered portion of the crest from the stone paved portion. The height of the core wall is not known but is presumed, from old undated drawings and from comments in a 1948 report, to extend the entire height of the dam.

In 1948, examination of the dam indicated leakage under the dam was occurring in two places, and there had been a partial failure of the downstream face of the dam. At that time, the Vermont Public Service Commission declared the dam was unsafe to store the maximum pool, and the pool elevation was limited by keeping the outlet gates completely open.

Various repairs were made to the dam including the placing of fill upstream and downstream of the masonry walls and where slope failures had occurred.

In about 1957 the Vermont Fish and Game Service rebuilt the spillway and outlet works of the dam. It is not clear if work was performed on the embankment sections of the dam at the same time.

In 1962, a major landslide occurred in the right abutment hillside immediately downstream of the outlet works. The landslide area has been regraded and seeded and a concrete retaining wall built at the toe of the slope forming a training wall downstream of the outlet works. The area of the slide and the concrete wall built in 1962 are shown in Photo 14.

At the time of the field inspection, the concrete wall was in good alignment and showed no signs of distress which can be attributed to continued movement of the landslide area.

c. Operating Records. No operating records were made available.

d. Post-Construction Changes. Since the original construction, a new outlet structure (1957) and training wall downstream of the outlet structure (1962) have been constructed at the right abutment of this dam. Additional information on this construction work is given above in Section 6.1.b.

e. Seismic Stability. The dam is located in Seismic Zone 2, and in accordance with recommended Phase I guidelines does not warrant seismic analysis.

SECTION 7
ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual inspection did not disclose any findings that indicate an immediate unsafe condition. The condition of the dam is generally good. The inspection revealed the following:

- (1) Seepage at the abandoned outlet drain pipe.
- (2) Cracking of concrete in the left training wall of the spillway section.
- (3) Displacement of the marble block riprap placed at the toe of the spillway in the spillway discharge channel.

The hydraulic analysis reveals that the dam cannot pass the required test flood.

b. Adequacy of Information. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgment.

c. Urgency. This dam is in generally good condition. The recommendations and remedial measures presented in Sections 7.2 and 7.3 should be implemented by the owner within two years of this Phase I Inspection Report.

d. Need for Additional Investigation. The findings of the visual inspection do not warrant additional investigation.

7.2 Recommendations

It is recommended that the owner engage a qualified engineer to evaluate further the potential for overtopping and the inadequacy of the spillway.

7.3 Remedial Measures

(a) Continued observation of the spillway channel floor for possible erosion beneath the paving. The marble block riprap at the toe of the spillway should be realigned.

(b) The left training wall of the spillway section should be repaired.

(c) The seepage at the abandoned outlet pipe should be monitored and further corrective measures taken should conditions so indicate.

(d) A written operational procedure and warning system to follow in the event of flood flow conditions or imminent dam failure should be developed. The warning system should discuss the operation of the gates during flood flow conditions and the steps to be taken by local officials for alerting downstream residents in case of emergency.

(e) A periodic technical inspection program should be initiated on a biennial basis.

7.4 Alternatives

There are no practical alternatives to the recommendations of Sections 7.2 and 7.3

APPENDIX A
VISUAL CHECKLIST WITH COMMENTS

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT 78498
Dufresne Pond Dam

DATE Nov. 9, 1978

TIME 8 a.m.

WEATHER Sunny & Cold

W.S. ELEV. 717.0 U.S. 710.5 DN.S

PARTY:

- | | |
|--|-----------|
| 1. <u>Gordon Slaney, HNTB</u> | 6. _____ |
| 2. <u>Stan Mazur, HNTB</u> | 7. _____ |
| 3. <u>Dan LaGatta, GEI</u> | 8. _____ |
| 4. <u>J. Peter Barranco, Jr. - Vermont Dept.</u> | 9. _____ |
| <u>of Water Resources</u> | |
| 5. _____ | 10. _____ |

PROJECT FEATURE	INSPECTED BY	REMARKS
1. <u>Embankment Dam</u>	<u>D. LaGatta</u>	
2. <u>Spillway, Sluiceway</u>	<u>S. Mazur, G. Slaney</u>	
3. _____		
4. _____		
5. _____		
6. _____		
7. _____		
8. _____		
9. _____		
10. _____		

PERIODIC INSPECTION CHECK LIST

PROJECT Dufresne Pond Dam

DATE Nov. 9, 1978

PROJECT FEATURE Embankment

NAME D. P. LaGatta

DISCIPLINE Geotechnical Engineer

NAME _____

AREA EVALUATED	CONDITION
<u>DAM EMBANKMENT</u>	
Crest Elevation	722.0
Current Pool Elevation	717.0
Maximum Impoundment to Date	Overtopped in 1973.
Surface Cracks	None visible.
Pavement Condition	No pavement
Movement or Settlement of Crest	None visible.
Lateral Movement	No misalignment observed.
Vertical Alignment	
Horizontal Alignment	
Condition at Abutment and at Concrete Structures	Good.
Indications of Movement of Structural Items on Slopes	None observed.
Trespassing on Slopes	None observed.
Sloughing or Erosion of Slopes or Abutments	None.
Rock Slope Protection - Riprap Failures	No riprap.
Unusual Movement or Cracking at or near Toes	None observed.
Unusual Embankment or Downstream Seepage	None observed.
Piping or Boils	None observed.
Foundation Drainage Features	None.
Toe Drains	None.
Instrumentation System	None.
Vegetation	Moderate brush growth on d.s. toe.

PERIODIC INSPECTION CHECK LIST

PROJECT Dufresne Pond Dam

DATE Nov. 9, 1978

PROJECT FEATURE Intake Channel/Structure

NAME D. P. LaGatta

DISCIPLINE Geotechnical/Hydraulic/Structural
Engineers

NAME G. Slaney, S. Mazur

AREA EVALUATED	CONDITION
<p><u>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</u></p> <p>a. Approach Channel</p> <p>Slope Conditions</p> <p>Bottom Conditions</p> <p>Rock Slides or Falls</p> <p>Log Boom</p> <p>Debris</p> <p>Condition of Concrete Lining</p> <p>Drains or Weep Holes</p> <p>b. Intake Structure</p> <p>Condition of Concrete</p> <p>Stop Logs and Slots</p>	<p>No special approach channel. Shoreline on right abutment leads to intake structure. Shoreline in good condition.</p> <p>Good.</p> <p>Good.</p>

PERIODIC INSPECTION CHECK LIST

PROJECT Dufresne Pond Dam

DATE Nov. 9, 1978

PROJECT FEATURE Control Tower

NAME _____

DISCIPLINE Structural Engineer

NAME S. Mazur

AREA EVALUATED

CONDITION

OUTLET WORKS - CONTROL TOWER

a. Concrete and Structural

General Condition

Condition of Joints

Spalling

Visible Reinforcing

Rusting or Staining of Concrete

Any Seepage or Efflorescence

Joint Alignment

Unusual Seepage or Leaks in Gate Chamber

Cracks

Rusting or Corrosion of Steel

b. Mechanical and Electrical

Air Vents

Float Wells

Crane Hoist

Elevator

Hydraulic System

Service Gates

Emergency Gates

Lightning Protection System

Emergency Power System

Wiring and Lighting System

This facility has no control tower.

PERIODIC INSPECTION CHECK LIST

PROJECT Dufresne Pond Dam

DATE Nov. 9, 1978

PROJECT FEATURE Transition and Conduit

NAME _____

DISCIPLINE Structural Engineer

NAME S. Mazur

AREA EVALUATED	CONDITION
<p><u>OUTLET WORKS - TRANSITION AND CONDUIT</u></p> <p>General Condition of Concrete</p> <p>Rust or Staining on Concrete</p> <p>Spalling</p> <p>Erosion or Cavitation</p> <p>Cracking</p> <p>Alignment of Monoliths</p> <p>Alignment of Joints</p> <p>Numbering of Monoliths</p>	<p>None.</p>

PERIODIC INSPECTION CHECK LIST

PROJECT Dufresne Pond Dam

DATE Nov. 9, 1978

PROJECT FEATURE Outlet Structure/Channel

NAME D. P. LaGatta

DISCIPLINE Structural/Hydraulic/Geotechnical Engineers

NAME S. Mazur, G. Slaney

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</u>	
General Condition of Concrete	Sluiceway, which is only way of out-letting water other than the spillway consists of hand-removable wooden stoplogs. Stoplogs and concrete in good condition.
Rust or Staining	
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	None.
Condition at Joints	Good.
Drain Holes	At waterline of discharge channel could not discern if they worked.
Channel	
Loose Rock or Trees Overhanging Channel	None.
Condition of Discharge Channel	Good.

PERIODIC INSPECTION CHECK LIST

PROJECT Dufresne Pond Dam

DATE Nov. 9, 1978

PROJECT FEATURE Spillway/Channel

NAME D. P. LaGatta

DISCIPLINE Structural/Hydraulic/Geotechnical
Engineers

NAME S. Mazur, G. Slaney

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u>	
a. Approach Channel	
General Condition	No special approach channel. Reservoir bank in good condition.
Loose Rock Overhanging Channel	None.
Trees Overhanging Channel	None.
Floor of Approach Channel	
b. Weir and Training Walls	
General Condition of Concrete	Good, left training wall - cracks crest of spillway, see text. Some at foot-bridge support.
Rust or Staining	
Spalling	None observed.
Any Visible Reinforcing	None observed.
Any Seepage or Efflorescence	None observed.
Drain Holes	None.
c. Discharge Channel	
General Channel	Floor of discharge channel has been paved with cut stone. See Photo 14
Loose Rock Overhanging Channel	Stones have been displaced but there is bedrock or larger boulders beneath paving stones.
Trees Overhanging Channel	
Floor of Channel	
Other Obstructions	

PERIODIC INSPECTION CHECK LIST

PROJECT Dufresne Pond Dam

DATE Nov. 9, 1978

PROJECT FEATURE Service Bridge

NAME _____

DISCIPLINE Structural Engineer

NAME S. Mazur

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SERVICE BRIDGE</u>	
a. Super Structure	
Bearings	Good (steel plates).
Anchor Bolts	Good.
Bridge Seat	Cracks at left training wall below bridge seat.
Longitudinal Members	Simple span truss, good condition.
Under Side of Deck	Good.
Secondary Bracing	Good.
Deck	Wooden planks, good condition.
Drainage System	None.
Railings	Top cord of truss, good condition.
Expansion Joints	None. Sliding plates with oversized holes.
Paint	
b. Abutment & Piers	
General Condition of Concrete	Bridge supports are two training walls; right training wall at outlet works structure and left training wall at spillway. Condition is good except as noted above.
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	



PHOTO NO. 1 - General view of reservoir from foot bridge.

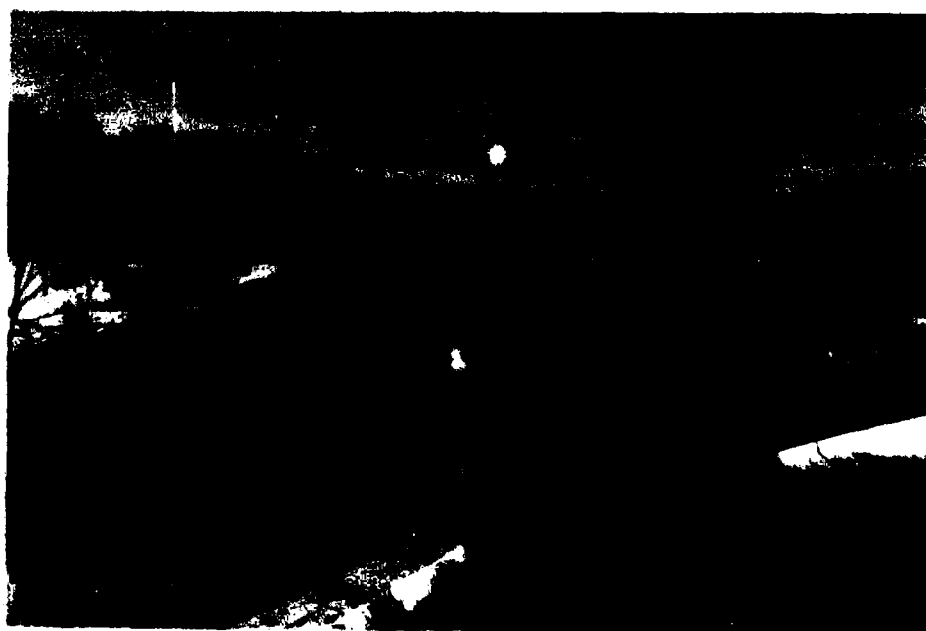


PHOTO NO. 2 - View of dam and reservoir.

APPENDIX C

PHOTOGRAPHS

FOR LOCATION OF PHOTOS, SEE FIGURE 1
LOCATED IN APPENDIX B

Safe channel capacity below the dam is limited to about 400 c.f.s., according to a report by the U. S. Army Engineers. Should the dam be breached, the sudden release of water would soon fill the channel and overflow the banks. Such a flood wave could cause considerable damage to the communities below.

A breach in the dam during a period of heavy rainfall would be much more disastrous. It is estimated that the worst possible storm may impose a flood flow on the system at this point sufficient to overtop the dam. The embankments would be easily washed out, making a much larger volume of water available to the flood.

The following recommendations are made:

(1) Remove the flashboards from the spillway crest as soon as possible to keep the pond as low as possible. (Plugged sluiceways will probably not permit further lowering of the pond). Keep the flashboards off until the unsafe condition of the dam is remedied.

(2) The dam should be removed or else extensive repairs should be made to recondition it. Since the dam is not being used for any purpose, it perhaps would be more economical to dismantle it.

STYPHEN H. HAYBROOK
HYDRAULIC ENGINEER

Public Service Commission

August 6, 1943

The dam impounds a reservoir of approximately 650,000 cubic feet at spillway crest level and over 1,300,000 cubic feet at full pond. The drainage area is 29 square miles.

Condition of the Dam:

An inspection of the dam on July 22, 1948 disclosed that the dam is in a run-down condition. Concrete in the spillway structure is badly spalled. Flashboards and other timbers are rotted. Part of the downstream face of the west embankment has sloughed away, producing a weak condition for full pond storage. Positive evidence of piping exists in two places. There is much leakage under the retaining walls containing the earth embankment just east of the spillway. Also, a definite flow path through the west embankment was observed.

There is no maintenance on the dam since the saw mill has been abandoned. The owner wishes to dispose of the property and thus tries only to maintain a pond as an added sale feature. Fortunately, leaky and rotted flashboards frequently lower the water behind the dam to spillway crest level.

Conclusions:

An inspection of the dam indicated that the dam is in a poor and unsafe condition. Because of the presence of piping, is kept in a weak condition and failure may result. Many with water at any level, but particularly so at the higher elevations.

The dam is located about 1 mile above the centers of population of Manchester Depot and Manchester Center, located along the stream.

RETYPE FROM AVAILABLE RECORDS.

REPORT ON THE UNSAFE CONDITION OF DUFRESNE DAM

Description of Structure:

This dam is located on the Batten Kill River in the village of Manchester Depot, town of Lancaster. It is owned by Mr. Cham Dufresne, who at one time operated the dam for power purposes for a saw mill. The dam is presently unattended.

Dufresne Dam consists of a concrete spillway section flanked by earth embankments on either side. The spillway structure is 40 feet long, and the right and left embankments are 78 feet and 135 feet in length, respectively. Thus, the total length of the dam is about 250 feet. Its maximum depth is about 12 feet. The top width averages 18 feet. Side slopes for both upstream and downstream faces of the earth fill are approximately 1 on 1. About 30 feet of the left embankment, measured from the spillway, is contained between masonry retaining walls. The earth fill in the embankment is composed of gravel and stone.

Discharge past the dam is handled by a spillway consisting of a concrete retaining wall, about 1 foot thick, supported by buttresses, all anchored to a foundation slab. The spillway crest has a net length of 40.3 feet and is 6 feet below the top of the dam. Flashboards, spanning between buttresses, are built up to within 1 foot of the top of the dam. A bridge of steel I-beams and plates provides access over the spillway structure.

INSPECTION REPORT

ON

Dufresne Dam

1. Date of inspection 4/10/52 2. Water conditions overflowing

GENERAL DATA:

3. Location of dam Batten Kill R. Manchester Depot
4. Owner and operator Cham Dufresne
5. Characteristic features of dam gravel & stone fill
retained by dry masonry walls; masonry spillway on east.
6. Other related data (see PSC file) - #2423

OBSERVATIONS:

7. Condition of structure same rundown condition noted
at time of hearing on the matter in 1948.
The embankment abutting the south end of
the spillway was stabilized by a timber crib
& refilled.
8. Condition of equipment same
9. Operation (PSC ruling that gates be kept
open with minimum pond level.
10. Maintenance (noted in "7" above)

REMARKS:

dam remains in an abandoned stage

Inspected by

PA/H

FILE COPY

AGENCY OF ENVIRONMENTAL CONSERVATION MONTPELIER

AGENCY MEMORANDUM SUBJECT

Dufresne Dam - Manchester

TO: Edward F. Kehoe, Commissioner, Department of Fish & Game

FROM: Donald H. Spies, Dam Construction Engineer
Department of Water Resources

DATE: November 10, 1972

The writer inspected the subject structure on November 2, 1972. The dam is an earth fill structure with a concrete core wall. The spillway consists of a flume structure with stop planks as the principal spillway and a concrete ogee weir as the emergency spillway.

The dam is in good shape. As with others, there is some brush and weeds in the rip-rap that need to be cut and sprayed. There appears to be some movement of the rip-rap; several of the stones show relative displacement and at a section near the spillways, there is a separation between the core wall and the rip-rap. This should be watched for a few years to see if the situation worsens. Also, near this section, there is a hole in the top of the fill on the other side of the core wall. It appears there is seepage through the drain pipe. The channel below the pipe should be cleaned out somewhat to facilitate the escape of the water.

cc: Robert Collins, Maintenance Supervisor
Richard Sears, Land Negotiator

ROUTING		
GENERAL		
TO	DATE	
DHS	11/13	
JEC	11/13	
EXTEND TO		
FILE		



FILE 6067

State of Vermont

Department of Fish and Game
Department of Forests and Parks
Department of Water Resources
Environmental Board
Division of Environmental Protection
Division of Recreation
Division of Planning
Natural Resources Conservation Council

ROUTING		
GENERAL		
TO	NOTED	DATE
DHS	DHS	11-13-75
DJM	DJM	11/14/75
ASR	ASR	11/13
SUSPENDED		
FILE		

AGENCY OF ENVIRONMENTAL CONSERVATION

MARTIN L. JOHNSON, Secretary

Montpelier, Vermont 05602

DEPARTMENT OF WATER RESOURCES

MANAGEMENT & ENGINEERING DIVISION

November 12, 1975

MEMORANDUM

To: File

From: Donald H. Spies

Subject: Dufresne Pond Dam - Manchester

On September 16, 1975, the writer inspected the subject structure and found it to be in generally good condition. The earth fill appeared to be properly maintained and it was noted most of the brush in the riprap had been cut. A little remains adjacent to and in the spillway area.

There is still seepage in the vicinity of the outlet of the pond drain. However, it was not possible to determine if leakage through the drain was the sole source of the water. The channel from the drain outlet to the river should be cleaned out to facilitate the flow of water away from the dam.

The retaining wall at the left (southerly) end of the ogee weir has a crack running from the crest of the weir to the bridge seat. This should be periodically monitored for change.

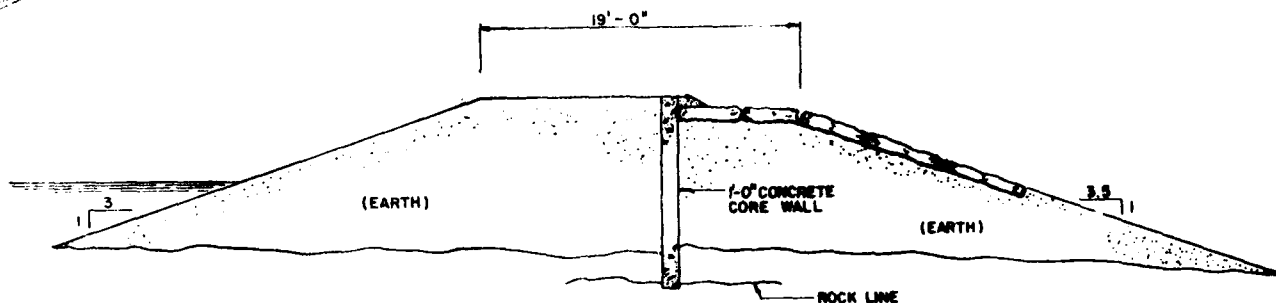
The ogee weir and the stop log structure were in good condition.

The footbridge over the spillways should be scheduled for repainting.

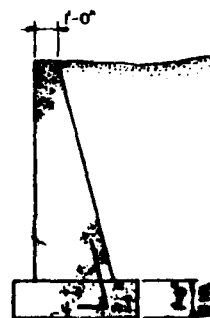
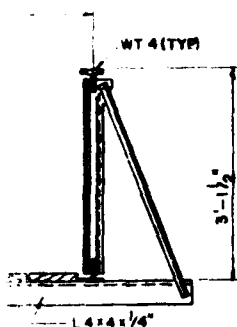
DHS/vdl

*advised FE through BRP,
11/17/75*

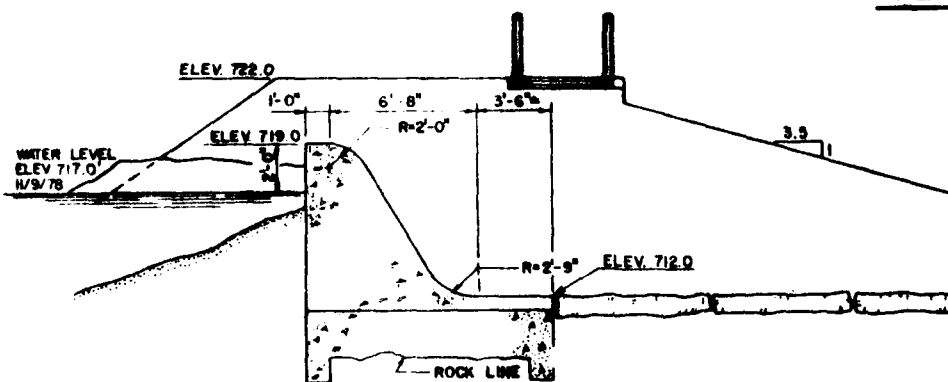
PAST INSPECTION REPORTS



SECTION C-C



SECTION D-D



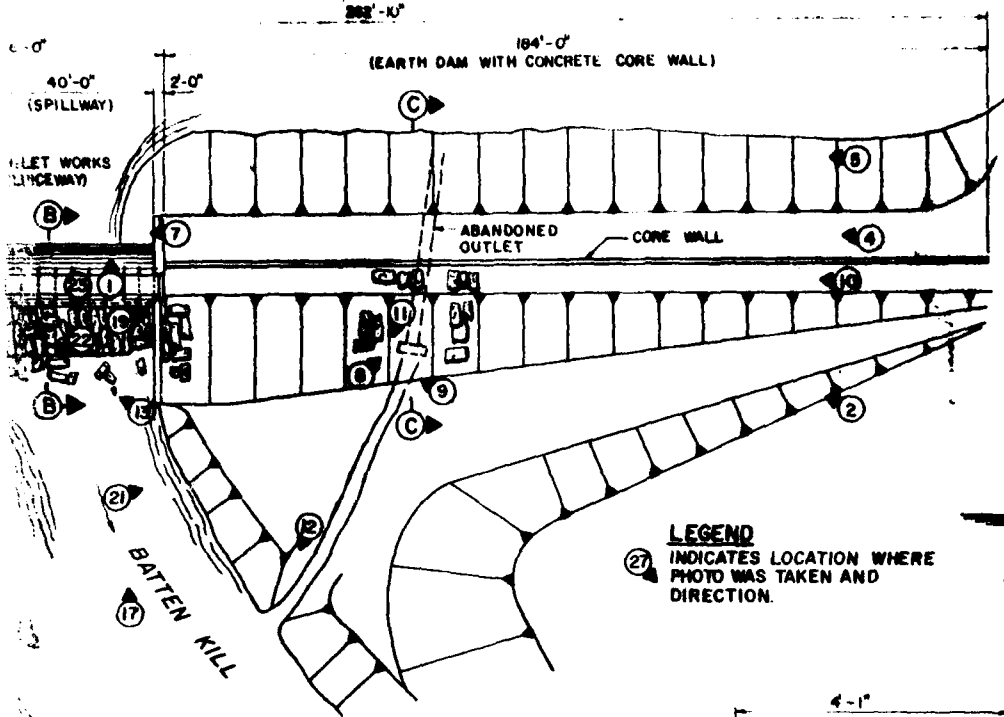
SECTION B-B

NOTES:

1. THE INFORMATION SHOWN ON THIS DRAWING IS BASED ON PARTIAL CONSTRUCTION PLANS AND VISUAL OBSERVATIONS MADE DURING THE FIELD INSPECTION. DIMENSIONS OR MATERIALS INDICATED ON THESE DRAWINGS WHICH WERE BELOW GRADE OR UNDER WATER DURING THE TIME OF INSPECTION WERE NOT VERIFIED.
2. THE ELEVATIONS SHOWN ARE BASED ON AN ELEVATION OF 710' SHOWN ON U.S.G.S. QUAD-RANGLE SHEET ASSUMED TO BE P.O.B. ELEVATION AT PERMANENT SPILLWAY CREST.

DESIGNED BY: [blank]	DATE: [blank]
CHECKED BY: [blank]	DATE: [blank]
NATIONAL PROGRAM OF INSPECTION OF DAMS FOR EARTHQUAKE	
DUFRESNE DAM	
OWNER: [blank]	ENGINEER: [blank]

3

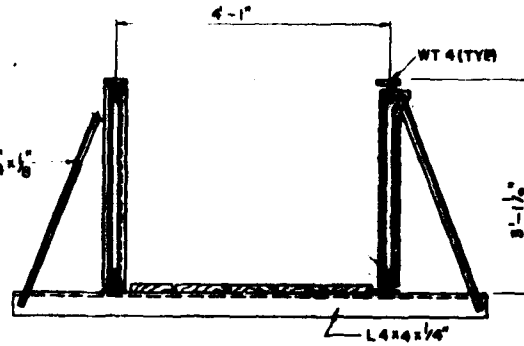


PLAN

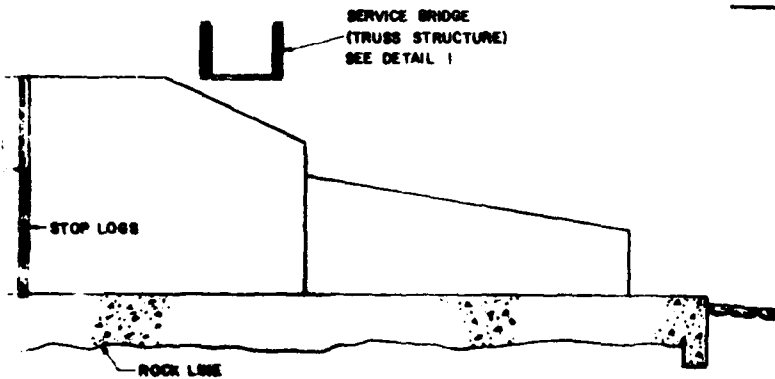
LEGEND
 (27) INDICATES LOCATION WHERE PHOTO WAS TAKEN AND DIRECTION.

THIS PHOTO TAKEN FROM BRIDGE FURTHER DOWNSTREAM.

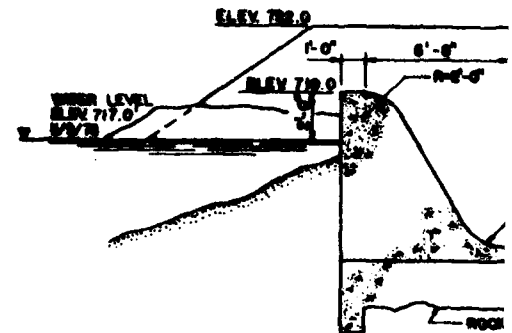
L 1/4" x 1/4" x 1/8" (TYP)



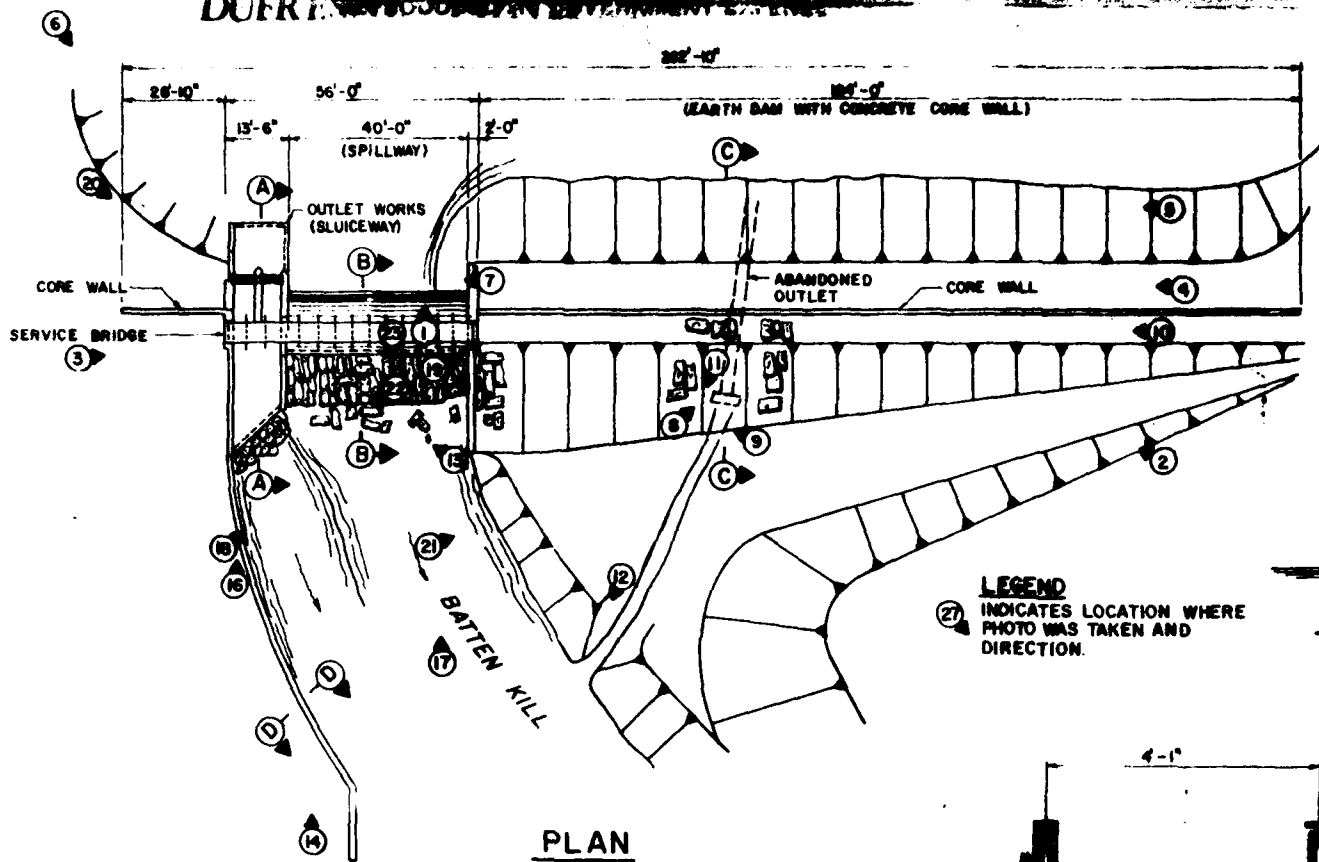
DETAIL 1



SECTION A-A

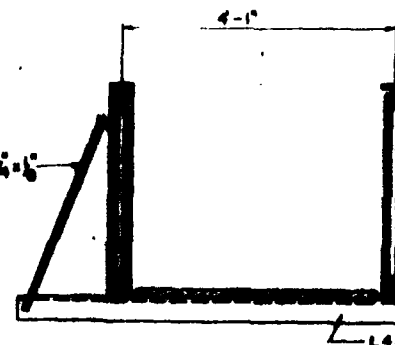


SECTION B-B

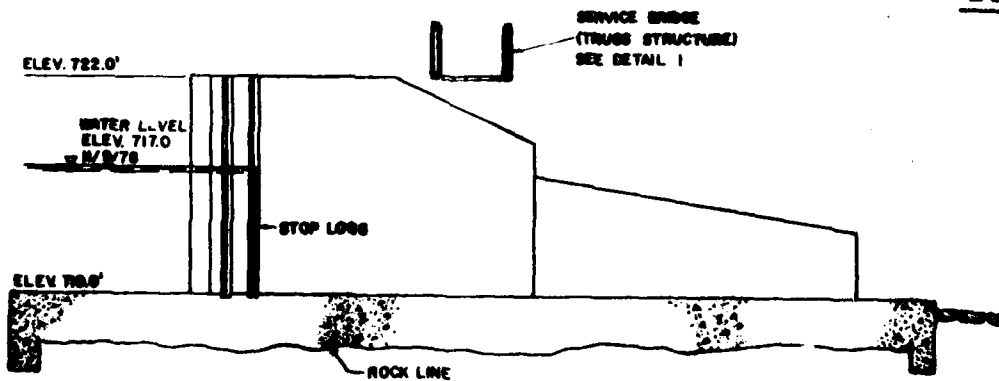


PLAN

(15) THIS PHOTO TAKEN FROM BRIDGE FURTHER DOWNSTREAM.



DETAIL 1



SECTION A-A

AVAILABLE ENGINEERING DATA

A drawing (1 sheet), dated 1962, showing additions and improvements made to the existing dam is available at the State of Vermont Agency of Environmental Conservation, Department of Water Resources, Montpelier, Vermont 05602.

APPENDIX B

1. LIST OF DESIGN, CONSTRUCTION AND MAINTENANCE RECORDS
2. PLANS AND DETAILS
3. PAST INSPECTION REPORTS

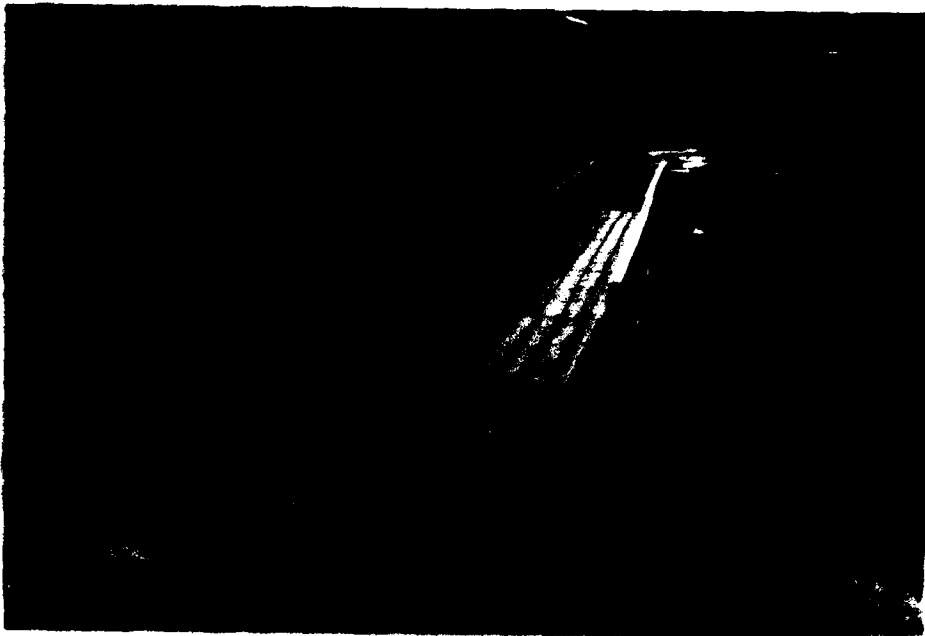


PHOTO NO. 3 - View of dam with appurtenant structures
from right abutment.



PHOTO NO. 4 - Crest of dam viewed from left abutment. Note top of concrete cut off wall and hand-placed marble slab slope protection.

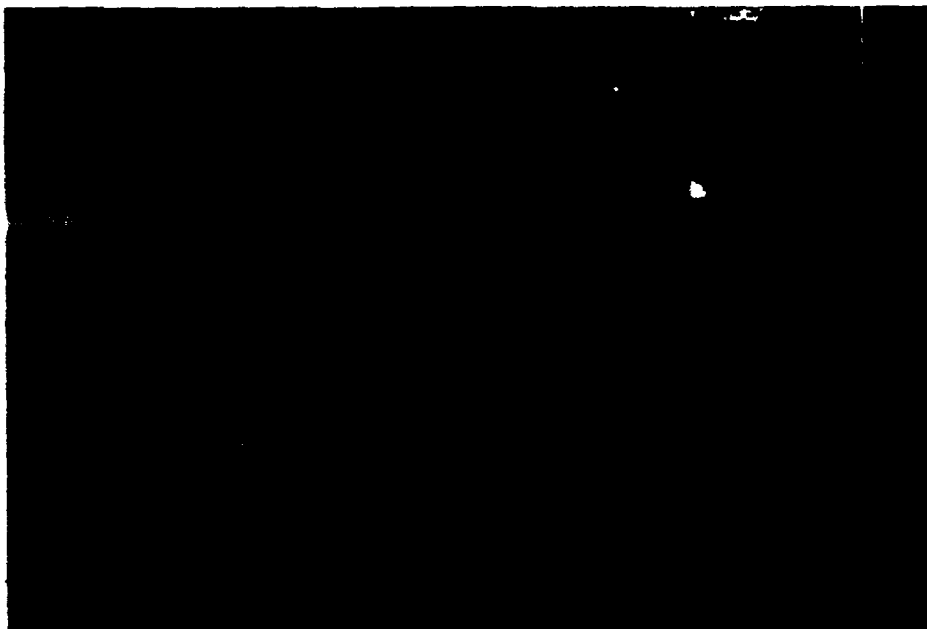


PHOTO NO. 5 - Upstream slope of dam from left abutment.
Note absence of riprap.



PHOTO NO. 6 - Upstream side of dam from right
abutment.

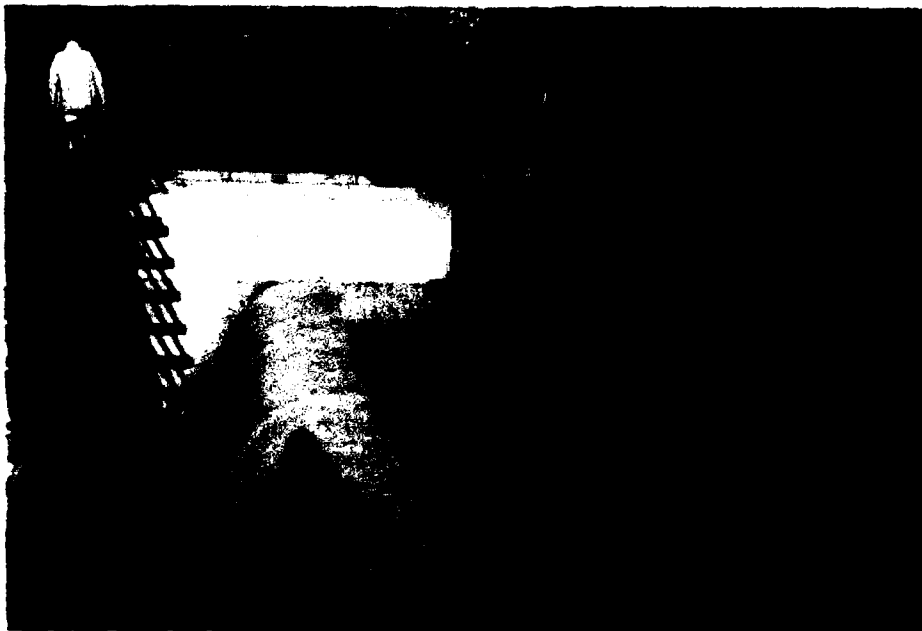


Photo No. 7 - Spillway crest viewed from left training wall. No misalignment of concrete structures due to embankment movement.

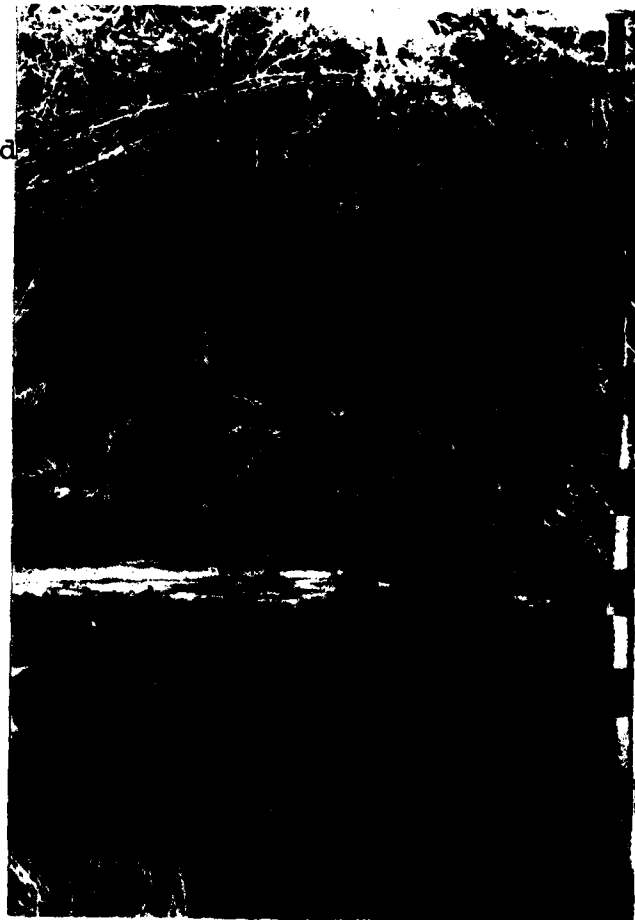


Photo No. 8 - Close up of abandoned outlet structure at downstream toe of embankment.



PHOTO NO. 9 - Downstream face of dam viewed from left abutment area downstream of embankment toe. Note partially cut bush on slope and position of abandoned outlet structure.



PHOTO NO. 10 - Downstream slope of dam viewed from left abutment. Note hand-placed marble slab slope protection.



PHOTO NO. 11 - Discharge from
abandoned outlet structure
viewed from outlet structure.



PHOTO NO. 12 - Confluence of discharge shown in
Photo 11 with Battenkill River.



PHOTO NO. 13 - View of spillway channel floor paving blocks. Note displacement of paving blocks.



PHOTO NO. 14 - Right training wall of discharge channel. Note area behind curved section of wall is the location of repaired landslide.

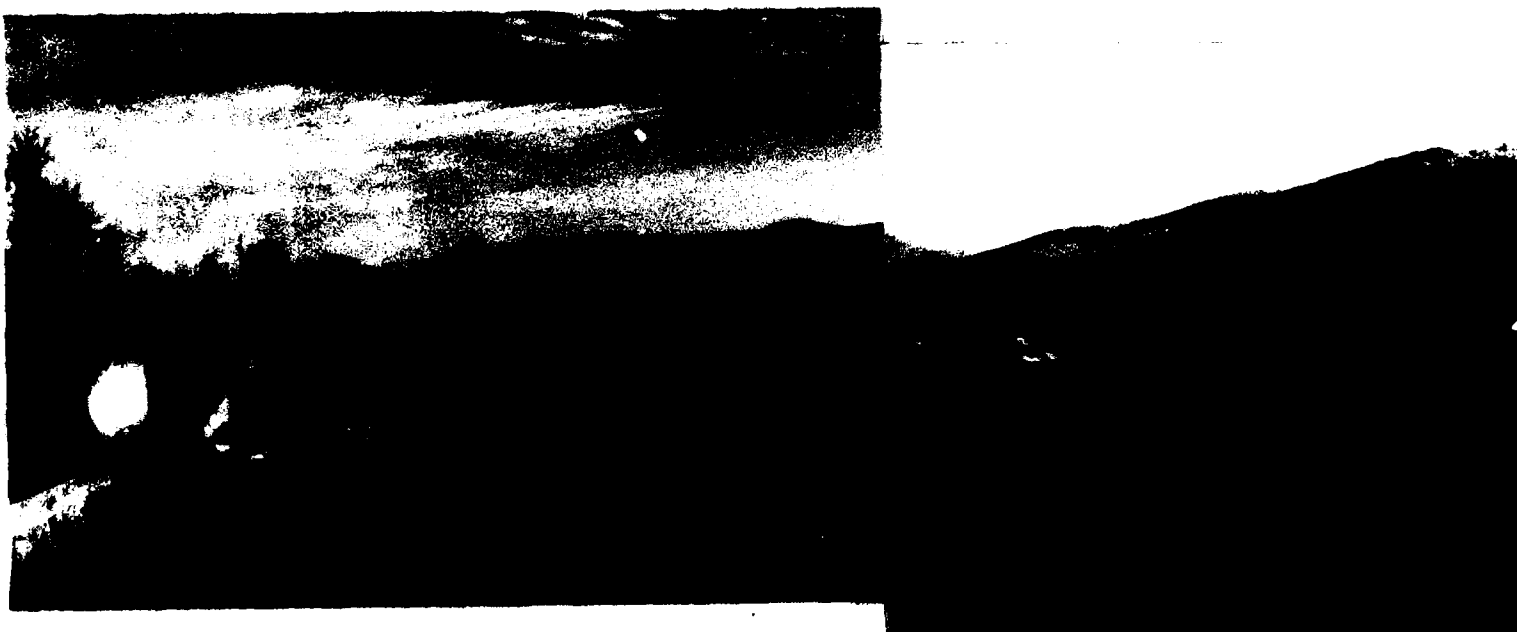


PHOTO NO. 15 - Composite photo of entire downstream face of dam.

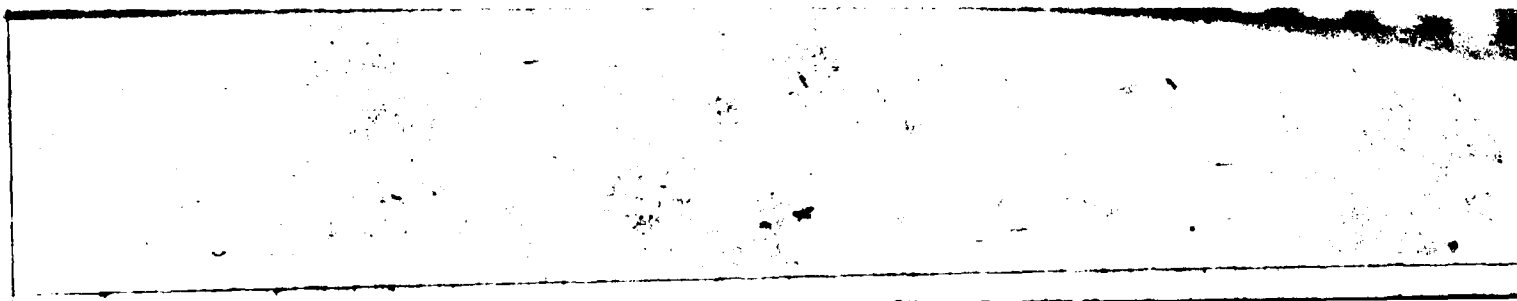




PHOTO NO. 16 - View of outlet works structure.



PHOTO NO. 17 - View of downstream face of spillway from spillway channel floor. Note bedrock outcropping in foreground.



PHOTO NO. 18 - Left training wall, deterioration of concrete between spillway crest and bridge seat.

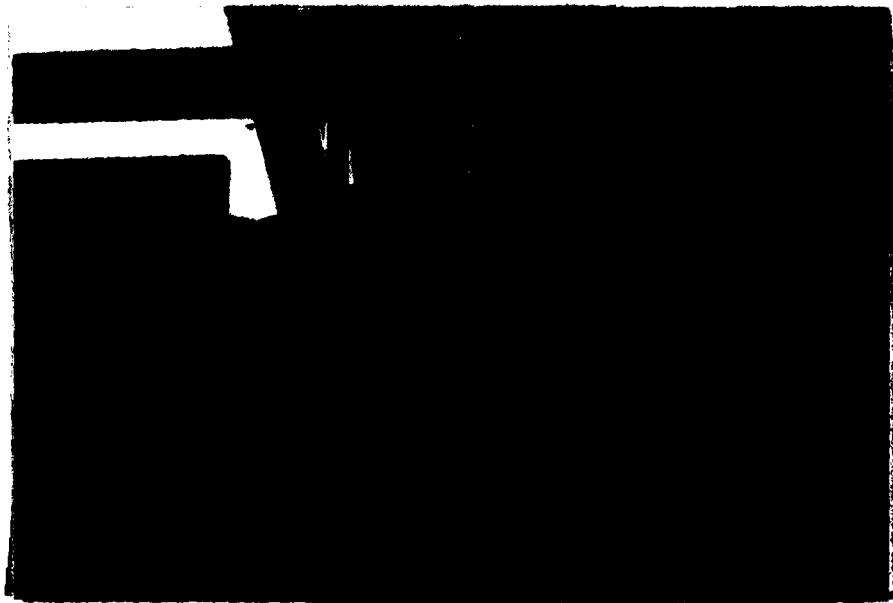


PHOTO NO. 19 - Close up view of concrete deterioration at left training wall.



PHOTO NO. 20 - Spillway and outlet works structure from upstream side.

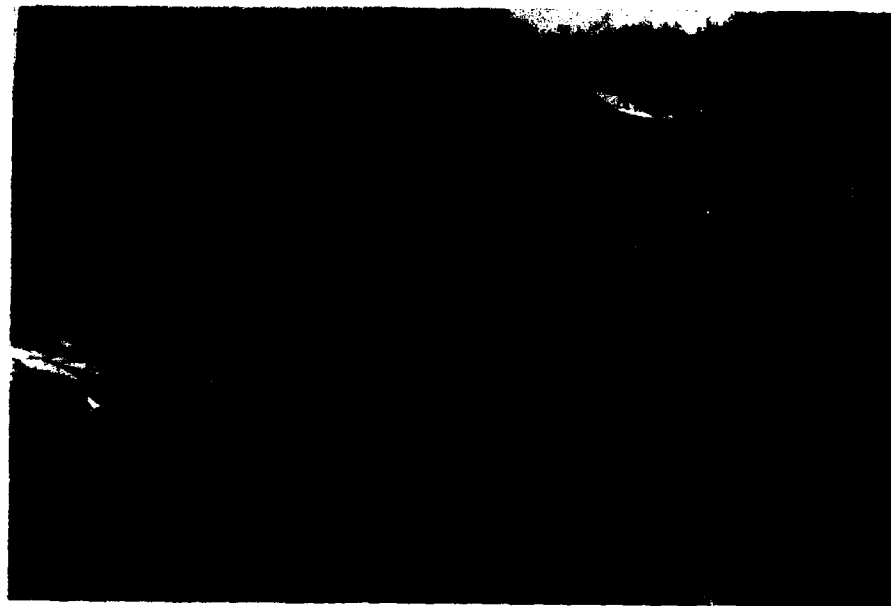


PHOTO NO. 21 - Downstream slope of dam from spillway channel.



PHOTO NO. 22 - Right training wall of outlet channel. Note - newer concrete wall discernable above and downstream of original wall shown at right.



PHOTO NO. 23 - Downstream discharge channel viewed from spillway bridge.

APPENDIX D
HYDROLOGIC AND HYDRAULIC COMPUTATIONS

HNTB HOWARD NEEDLES TAMMEN & BERGENDOFF For	Made by	Date	Job No.
	Checked by	Date	Sheet No.
DUFRESNE DAM			

HYDRAULICS & HYDROLOGY

Dufresne Dam Located in Manchester, Vt along
Batten Kill in the Hudson River Basin

Classification SIZE: SMALL
HAZARD: significant

Basic Data DA. \approx 18.4 sq mi (HNTB calculation)
Upstream Basin: ROLLING ave Slope 2.7%
discounting upper 15% of basin.

Reservoir: Normal pool elev. 719.0 USGS
Storage 52 acre-ft
Max. pool elev. 722.0
Storage 100 acre-ft
Surface 12.8 acres ave
16 acres max

Dam: Earth w/ concrete core
12' max height
263' long

Spillway: concrete weir -
elev. 719.
length 40'

Outlet: 2- 4.5' wide stop log gates
invert 710. with no logs.

HNTB

HOWARD NEEDLES TAMMEN & BERGENDOFF

For

DUFRESNE DAM

Made by

RY

Date

11/15/78

Job No.

5628-11-19

Checked by

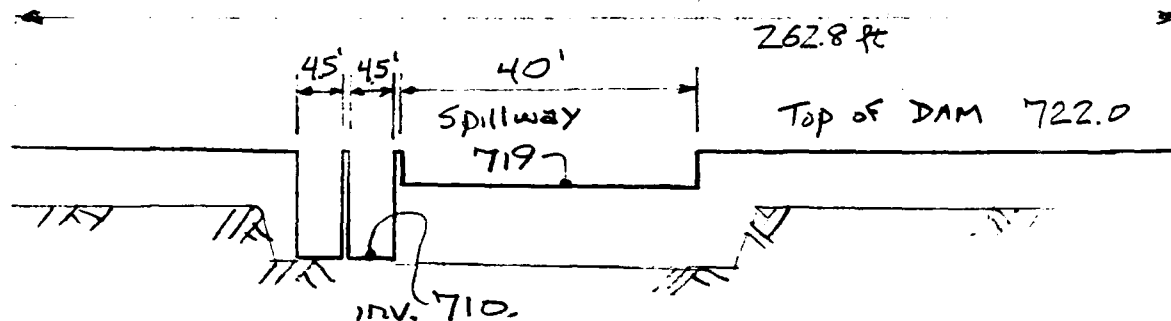
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Date

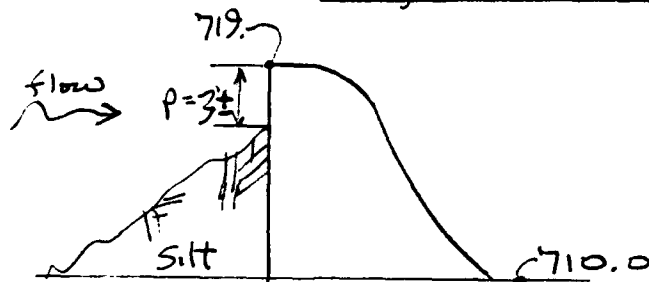
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Sheet No.

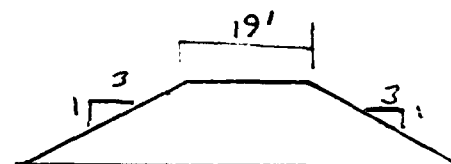
2



Longitudal section along dam
looking upstream



spillway section



Dam section

STEP 1

CALCULATION OF SPILLWAY DESIGN FLOOD

CLASSIFICATION

size - SMALL

hazard - significant

Hydrologic evaluation Guideline Recommends

100 year to $\frac{1}{2}$ PMFUSE $\frac{1}{2}$ PMF as 100yr flood discharge would be outside of PMF curve envelopeBasin - Rolling therefore PMF = 1470 cfs/sq.mi.

$$\frac{1}{2} \times 1470 \text{ cfs/sq.mi.} \times 18.4 \text{ sq.mi.} = 13,524 \text{ cfs}$$

USE SDF = 13,500 cfs

HNTB HOWARD NEEDLES TAMMEN & BERGENCOFF For <u>DUFRESNE</u>	Made by <u>RY</u>	Date <u>11/15/78</u>	Job No. <u>5628-11-19</u>
	Checked by <u>MURPHY</u>	Date <u>1/16/79</u>	Sheet No. <u>3</u>

STEP 2 Calculation of Surcharge by PMF

PMF = Spillway design flood = 13,500 cfs.

Consider: stoplogs in place to elev. 719.0

Spillway: $Q_s = C_e L H^{3/2}$
 where $C_e = 3.22 + .40 \left(\frac{H}{P} \right)$ $P = 30'$ (see pg. 2)
 $L = 40' + 9.0' \text{ (gates)} = 49.0'$

dam: $Q_D = C L H^{3/2}$
 where: $C = 3.60$ (trapezoid weir)
 $L = 262.8' - 49' = 213.8'$
 $49' = \text{length of spillway \& outlet works}$

Total flow = flow spillway + flow dam

$$Q_T = Q_s + Q_D$$

Water Elev	Head Spillway	Q_s	Head Dam	Q_D	Q_T
719.0	0		0	—	0
722.0	3 ft	921 cfs	0	—	921 cfs
724.0	5 ft	2130	2 ft	2177 cfs	4310
726.0	7 ft	3769	4 ft	6157	9930
728.0	9 ft	5848	6 ft	11312	17,160
730.0	11 ft	8378	8 ft	17416	25,800
731.0	12 ft	9817	9 ft	22781	30600

HNTB HOWARD NEEDLES TAMMEN & BERGENDOFF For <u>DUFRESNE DAM</u>	Made by <u>RY</u>	Date <u>11/16/78</u>	Job No. <u>5628-11-19</u>
	Checked by <u>PUP</u>	Date <u>11/17/79</u>	Sheet No. <u>4</u>

STEP 3 EFFECT OF surcharge storage on MPF

Height of surcharge storage = 8.0'
for $Q_{P1} = 13,500$ cfs. see fig 1

surcharge volume $STOR_1$

$$STOR_1 = \frac{8.0 \times 12 \text{ ft} \times 16 \text{ acres}}{18.4 \text{ sq. mi.} \times 640 \frac{\text{acres}}{\text{mi}^2}} = 0.1304 \text{ in.}$$

$$Q_{P2} = Q_{P1} \left(1 - \frac{STOR_1}{9 \frac{1}{2}}\right) = 13,500 \left(1 - \frac{.1304}{9.5}\right) = 13,315 \text{ cfs}$$

surcharge height₂ = 7.98 ft

$$STOR_2 = \frac{7.98 \times 12 \times 16}{18.4 \times 640} = 0.1301 \text{ in.}$$

$$STOR_{AVE} = \frac{.1301 + .1304}{2} = .13025 \text{ in.}$$

$$Q_{P3} = Q_{P1} \left(1 - \frac{STOR_{AVE}}{9 \frac{1}{2}}\right) = 13,315 \text{ cfs}$$

Surcharge₃ = 7.98' elev 726.98

Values will not change no further iterations necessary.

CONCLUSIONS

1. Reservoir storage will reduce the SDF from 13,500 cfs to 13,315 cfs or by 1.3%

2. The spillway and storage capacity can safely pass 7.7% of the test flood.

3. At the test discharge of 13,315 the dam crest will be overtopped by 4.98 ft

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JOIN TO THE INPM

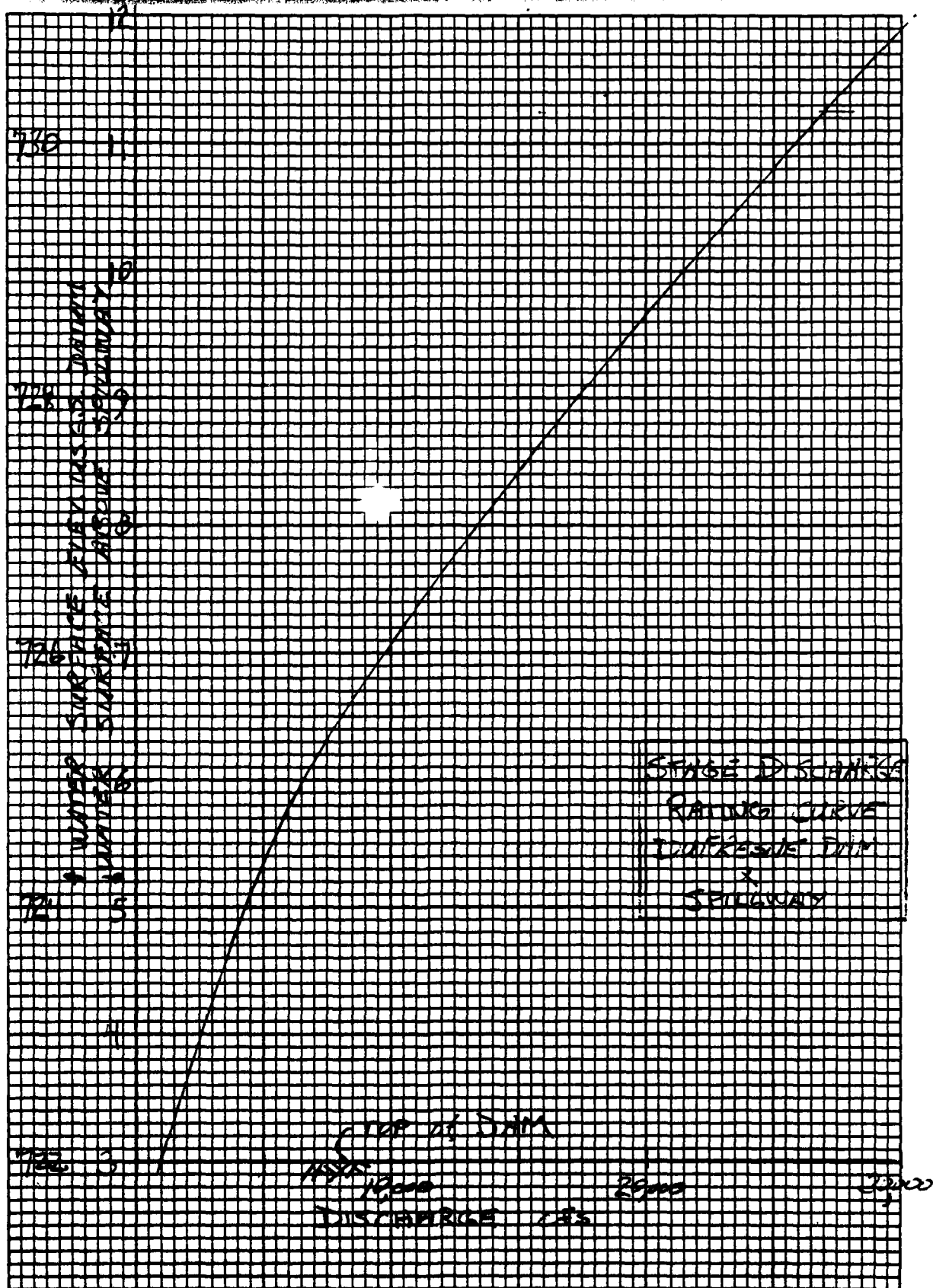


FIG. 1

HNTB HOWARD NEEDLES TAMMEN & BERGENCOFF For <u>DUFRESNE DAM</u>	Made by <u>Ry</u>	Date <u>11/15/78</u>	Job No. <u>5628-11-19</u>
	Checked by <u>MPY</u>	Date <u>1/16/79</u>	Sheet No. <u>5</u>

ESTIMATE OF DOWNSTREAM DAMAGE

Step 1 Reservoir Capacity

Normal Pool 52 acre-ft elev 719.
Max Pool 100 acre-ft elev 722.

STEP 2 PEAK FAILURE OUTFLOW

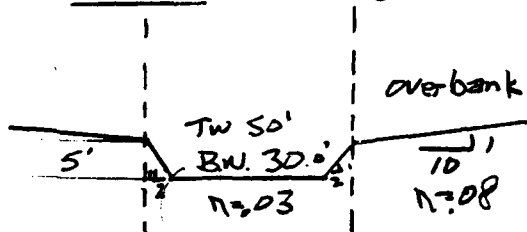
$$Q_R = 8/27 W_b \sqrt{g} Y_o^{3/2}$$

W_b = 40% of the dam width

Y_o = height from river to pool level

$$Q_{P1} = 8/27 \sqrt{g} (.40)(262.8)(12)^{3/2} = 7340 \text{ cfs}$$

STEP 3 Stage-Discharge Routing Curve



Reach Characteristics
 $L = 7000'$

$$S = 0.0029$$

$n = .03$ channel
 $.08$ overbank

<u>Stage</u>	<u>Channel Discharge</u>	<u>Overbank Discharge</u>	<u>Total Q</u>
5 ft	1300 cfs		1300 cfs
8	3316	134 cfs	3450
10	5046	460	5510
12	7049	1126	8145

see fig 2.

HNTB

HOWARD NEEDLES TAMMEN & BERGENDOFF

For

DUFRESNE DAM

Made by

RY

Date

11/15/78

Job No.

5628-11-12

Checked by

PUB

Date

11/16/79

Sheet No.

6

STEP 4 $Q_{P1} = 7340 \text{ cfs}$ Stage 11.4' area 930'

$$V_1 = \frac{3000 \times 930}{43,560} = 64 \text{ acre ft} > \frac{100}{2}$$

Reach too long

 $L = 1000'$

$$V_1 = \frac{1000 \times 930}{43,560} = 21.3 \text{ acre ft} < \frac{100}{2}$$

$$Q_{P1 \text{ Trial}} = 7340 \left(1 - \frac{21.3}{100}\right) = 5776 \text{ cfs}$$

$$\text{Stage}_2 = 10.3 \text{ ft area} = 746'$$

$$V_2 = \frac{746 \times 1000}{43,560} = 17.1 \text{ acre ft}$$

$$V_{\text{AVE}} = \frac{21.3 + 17.1}{2} = 19.2 \text{ acre ft}$$

$$Q_{P2} = 7340 \left(1 - \frac{19.2}{100}\right) = 5930 \text{ cfs}$$

$$\text{Outflow} = 5930 \text{ cfs}$$

$$\text{Stage} = 10.4 \text{ ft}$$

STEP 5

Reach 2 same as STEP 4 reach

 $L = 2000'$

Total 3000'

$$Q_{P1} = 5930 \text{ stage } 10.4 \text{ area} = 762'$$

$$V_1 = \frac{2000 \times 762}{43,560} = 35.0 \text{ acre ft} < \frac{100}{2}$$

Reach length OK

$$Q_{P2 \text{ Trial}} = 5930 \left(1 - \frac{35}{100}\right) = 3854 \text{ cfs}$$

HNTB HOWARD NEEDLES TAMMEN & BERGENDOFF For <u>DUFRESNE DAM</u>	Made by	R.Y.	Date	11/15/78	Job No.	5628-11-19
	Checked by	P. J. P.	Date	1/16/79	Sheet No.	7

$$\text{Stage}_2 = 8.40 \text{ ft} \quad \text{Area}_2 = 486 \text{ ft}^2$$

$$V_2 = \frac{486 \times 2500}{43,560} = 22.3 \text{ acre-ft}$$

$$V_{AVE} = \frac{22.3 + 35}{2} = 28.7 \text{ acre-ft}$$

$$Q_{P2} = 5930 \left(1 - \frac{V_{AVE}}{5}\right) = 5930 \left(1 - \frac{28.7}{100}\right) = 4230$$

$$\text{Outflow} = 4230 \text{ cfs}$$

$$\text{Stage} = 8.8 \text{ ft}$$

STEP 6

Reach 3 same as Step 4 reach

$$L = 3500 \text{ ft}$$

$$\text{Total } 6500 \text{ ft}$$

$$Q_P = 4230 \text{ cfs} \quad \text{Stage } 8.8 \text{ ft} \quad \text{area} = 534 \text{ ft}^2$$

$$V_1 = \frac{534 \times 3500}{43,560} = 4.3 \text{ acre-ft} < \frac{100}{2}$$

Reach Length OK

$$Q_{P2} = 4230 \left(1 - \frac{4.3}{100}\right) = 2411 \text{ cfs}$$

$$\text{Stage}_2 = 6.8 \text{ ft} \quad \text{area}_2 = 322 \text{ ft}^2$$

$$V_2 = \frac{322 \times 3500}{43,560} = 25.9 \text{ acre-ft}$$

$$V_{AVE} = \frac{25.9 + 4.3}{2} = 34.50 \text{ acre-ft}$$

$$Q_{P2} = 4270 \left(1 - \frac{34.5}{100}\right) = 2770 \text{ cfs}$$

$$\text{Outflow} = 2770 \text{ cfs}$$

$$\text{Stage} = 7.3 \text{ ft}$$

HNTB HOWARD NEEDLES TAMMEN & BERGENDOFF	Made by	RY	Date	11/15/78	Job No.	5628-11-19
	Checked by	MPJ	Date	1/16/78	Sheet No.	8
For DUFRESNE DAM						

ROUTING SUMMARY

<u>END of Reach</u>	<u>Discharge</u>	<u>Stage</u>
At Dam	7340 cfs	11.4 ft.
1000' ds. of dam	5930	10.4 ft
3000' d.s of dam at Route 30.	4230	8.8 ft
6500' ds of dam at bridge on Richville Rd.	2770	7.3 ft

DE IN

10x10 TO THE INCH

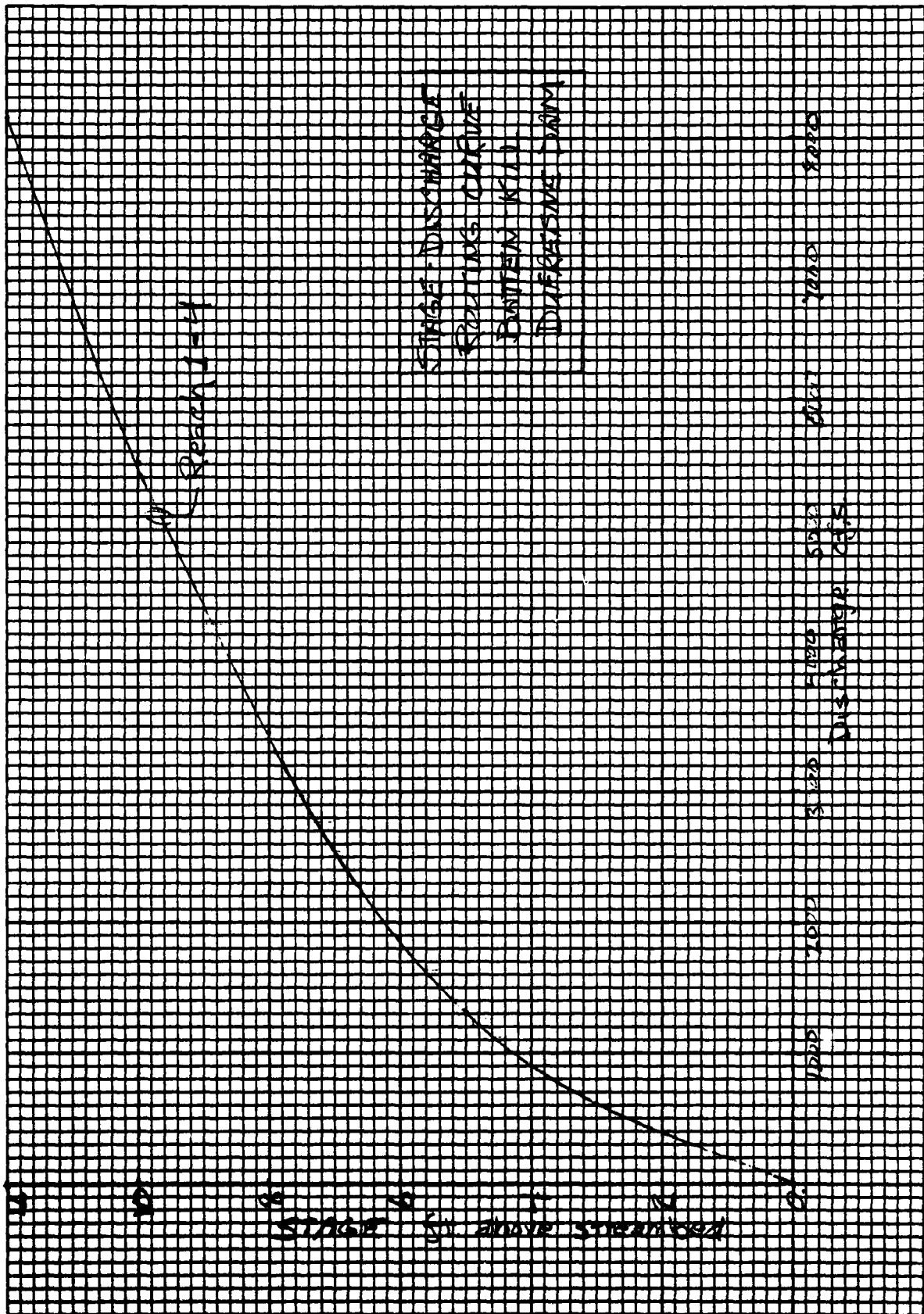
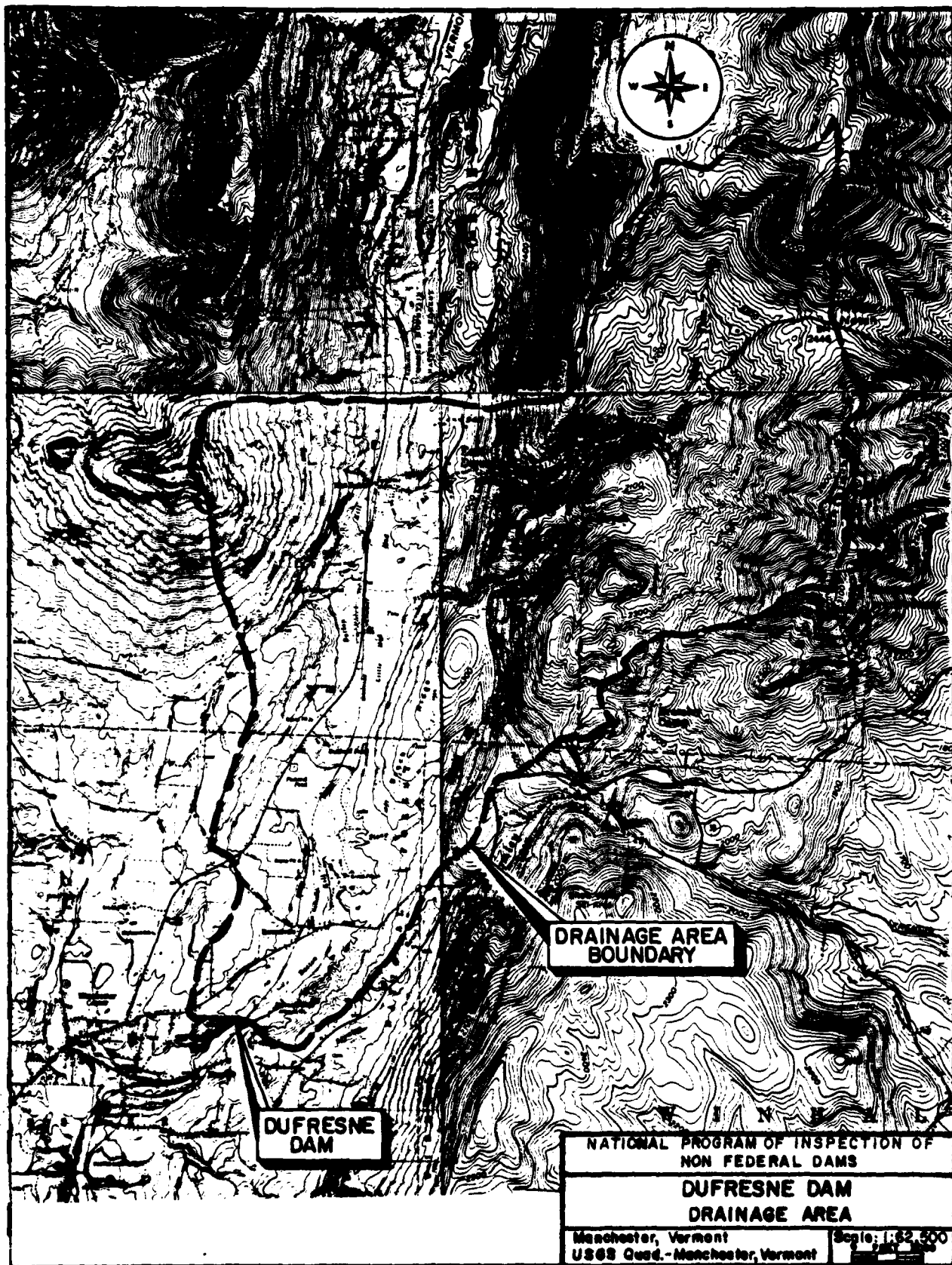
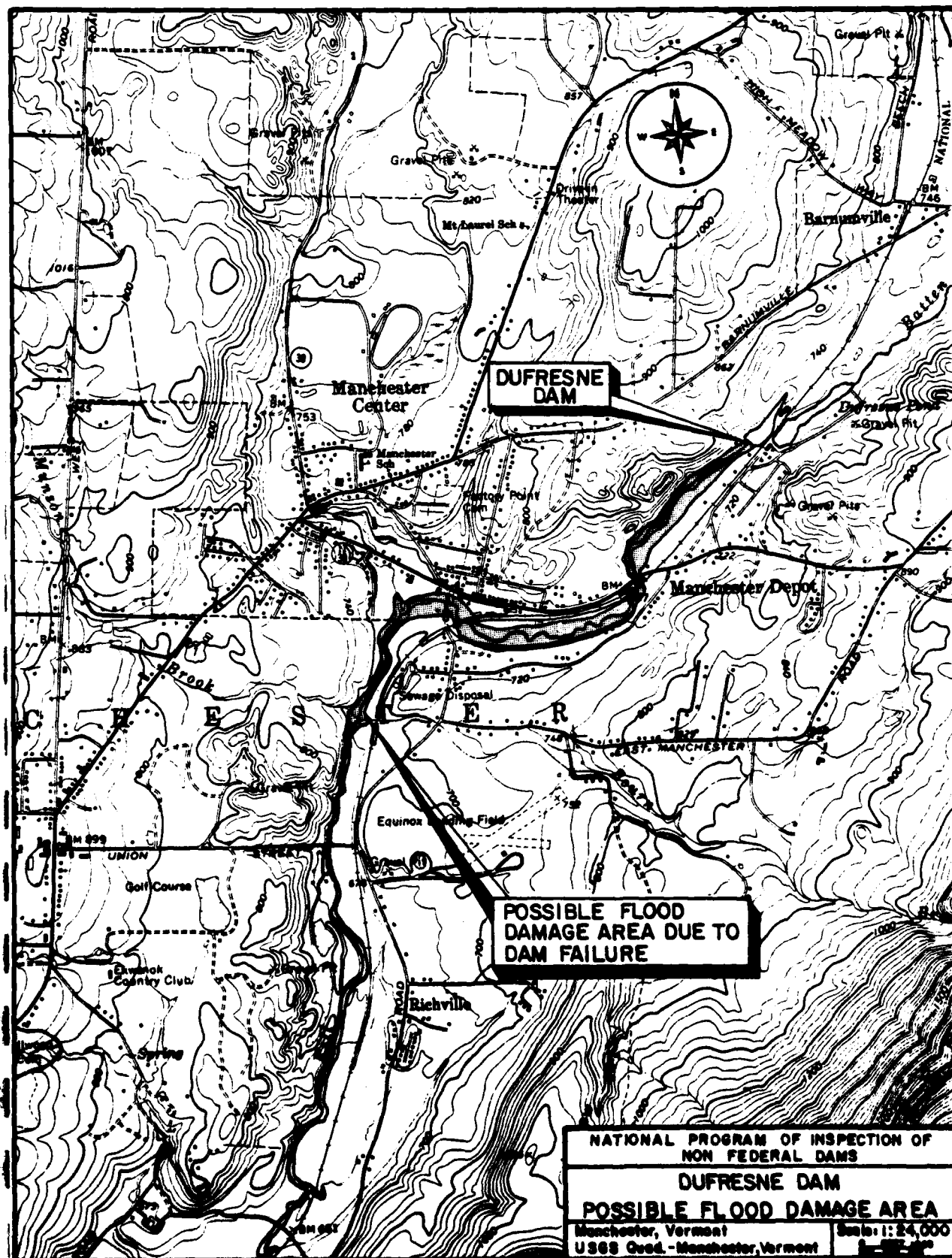


FIG. 2



Manchester, Vt.



APPENDIX E

INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS

DATE
FILMED
-8